

JOURNAL

U.S. ARMY MEDICAL DEPARTMENT

OPERATION *Desert Storm*

October – December 2001

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U.S. ARMY MEDICAL DEPARTMENT
A Professional Bulletin for the AMEDD Community

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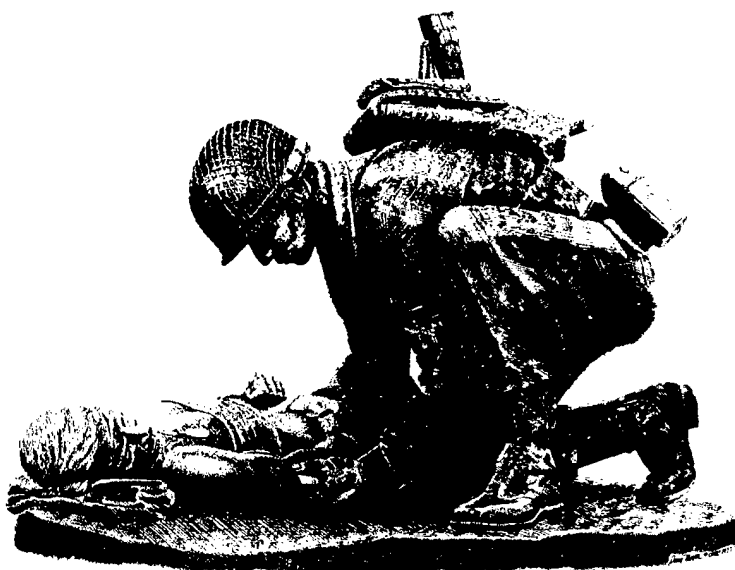
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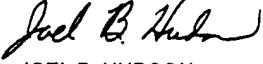
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From the Chairman, Editorial Review Board **12 September 2001**

James M. Lamiell, Colonel, Medical Corps

It is difficult to compose this *AMEDD Journal* Perspective less than 24 hours after the beginning of our national terrorist-war. Of course, terrorist attacks did not commence yesterday, and we have lived with them for a long time. Such attacks frequently involve military targets, as did the attack against the Pentagon yesterday. My memory includes aircraft hijackings beginning in the 1950's and bombings or hostage incidents involving U.S. military billets in Vietnam, various sites in Europe, Central and South America, the Middle East, Oklahoma City, Africa, and Yemen. This list is not inclusive, and it is seemingly endless.

Yesterday's events changed everything for America in a dramatic way. Four aircraft were hijacked and three were employed as effective and lethal weapons in coordinated attacks against major symbols of American economic, political, and military power. The toll in terms of human suffering is unknown today, but it must be enormous. Hundreds were injured and thousands lost their lives. The magnitude of yesterday's tragedy makes 11 September 2001 a demarcation, a watershed, and a rift in history. One must look back to the Civil War to find anything comparable that occurred on American soil. We can all relate to this homeland attack against ordinary American citizens. Our condolence and prayers go out to all the victims of the terrorist attack and their relatives. We all want to do something to alleviate the suffering and to see that justice is done. The long lines at blood banks across America are just one dramatic indication of our national resolve.

What was our transgression and why were we attacked? Who is our enemy? Our terrorist-war will probably be prolonged. The AMEDD must be prepared and engaged, and this will require diligence and persistence. Numerous complex and important issues confront us including, but not limited to, developing effective medical responses to weapons of mass destruction, disasters, and mass casualty incidents. We must deal with new concepts like asymmetric conflict, information warfare, and the inherent vulnerability of an open society. This *AMEDD Journal* issue is intended to commemorate the tenth anniversary of the Persian Gulf War. In preparation for future challenges, please consider taking a few minutes to look back 10 years to a conflict in which, perhaps at least some of the seeds of yesterday's events were sewn.

In this issue you will find informative articles about the Persian Gulf War deployment experience, depleted uranium, monitoring health outcomes and occupational health, vision readiness, and the pharmacy of deployments. Reading about the personal experiences of forward medical company and evacuation hospital staff is enlightening. Are you familiar with Goat Teams? Read on!

You will find approximately 1,000 citations related to the Persian Gulf War if you search MEDLINE with terms like Persian, gulf, war, desert, storm, and shield. Some of these articles will be useful as you prepare for the terrorist-war. The U.S. Army Center of Military History (<http://www.army.mil/cmh-pg>) has some useful Southwest Asia War (Gulf War) information; see the links at URL <http://www.army.mil/cmh-pg/online/Bookshelves/Swa.htm>. You may find the oral history interviews at <http://www.army.mil/cmh-pg/documents/SWA/DSIT/DSIT.htm> to be informative. Look carefully at the oral histories to find commentaries from some prominent AMEDD personnel. Finally, see <http://review.detrick.army.mil/history/booksdocs/books.htm> for links to many old *AMEDD Journal* Persian Gulf War articles.

As you look to the future, keep the cardinal virtues in mind: wisdom, courage, justice, and temperance.

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The 15th Evacuation Hospital. . .

Looking Back at a Job Well Done

The AMEDDC&S Commander talks about the challenges of deploying, establishing, and commanding a large hospital while providing optimum health care during the Gulf War crisis.



Major General Kevin C. Kiley †

A decade ago, the United States and its coalition partners decisively defeated the Iraqi Army during Operations Desert Shield/Storm. This conflict provided the multinational alliance with the opportunity to demonstrate numerous advancements of the military capabilities of the United States Armed Forces. The Army Medical Department (AMEDD) also actively participated in preparing for the predicted thousands of casualties based on the anticipated strength of the Iraqi Army. Overall, American casualties proved to be extremely light; however, advances in the delivery of health care on the battlefield were nonetheless shown to be beneficial. The following are some of my thoughts and observations on the performance of the AMEDD and the medical unit I commanded in this unique and limited war.

I assumed command of the 400-bed 15th Evacuation (Evac) Hospital stationed at Fort Polk, LA, on 10 December 1990. I had previously commanded the 10th Medical Battalion, Fort Drum, NY, from 1985 to 1988, prior to being Chief, Obstetrics and Gynecology Service, William Beaumont Army Medical Center at the onset of hostilities. This previous experience helped to facilitate a smooth change of command from COL George Collins, Medical Service Corps, who commanded the 15th Evac during peacetime. From the onset, the preparation for deployment went smoothly, as the personnel needed for mobilization arrived. The Professional Filler System

(PROFIS) had the right demographics of physicians and nurses for proper hospital operation. Few problems were encountered since 60% to 70% of these officers came from Bayne-Jones Army Community Hospital at Fort Polk. My main objective for the PROFIS officers, who had varying levels of experience, was to teach the war fighters' perspective in terms of "shoot, move, and communicate." This allayed some of the apprehension about deployment and familiarized them with critical Common Task Training (CTT) skills such as field sanitation; nuclear, biological, and chemical warfare; and weapons skills. In addition to CTT, the medics and noncommissioned officers worked on their basic medical skills prior to deployment. The only shortfall in enlisted technical staff was in military occupational specialty (MOS) 91D, operating room technicians; however, several of the MOS 91B combat medics were trained to perform in this capacity. While training and personnel issues progressed well, the readiness of hospital equipment was an unknown. The hospital had been recently outfitted in a Deployable Medical Systems (DEPMEDS) configuration with equipment that was already forward deployed. This did not allow for inspection and familiarization with this equipment; however, these hospital systems later proved to be correctly profiled.

After a month of preparation, the hospital personnel

eventually deployed on 7 January 1991. They spent a week in the Khobar Towers prior to convoying to Log Base Victor to pick up military-owned demountable containers and the DEPMEDS equipment. The hospital arrived at Log Base Charlie (6 kilometers south of the Iraqi border) on 25 January and became operational on 31 January with 60 patient beds. The hospital became fully operational with 400 patient beds on 7 February. The capabilities included eight operating rooms, intensive care units, and laboratory and radiology support services. Our mission at the 15th Evac was to support medical units in the 18th Airborne Corps sector, specifically those in the 101st Airborne and 24th Infantry Divisions. The hospital was one of the five evacuation hospitals in the 62d Medical Group. We received patients primarily from the 5th Mobile Army Surgical Hospital (MASH) and the 41st Combat Support Hospital, 1st Medical Group.

Preparation time for the ground war was relatively short, but the hospital was utilized immediately given the frequency of both major and minor accidents that occurred along Tapline Road and elsewhere in the theater. A significant amount of time was spent in working through some minor operational problems. Issues such as showers, meals, and field sanitation were emphasized by my command to ensure the morale of the personnel. From a technical standpoint, both the officers and enlisted personnel performed superbly in their respective jobs and few command and control difficulties arose. Because there was only one company commander for the entire hospital, the Deputy Commander for Clinical Services served as the platoon leader for the officers and four platoon sergeant positions were created to assist the enlisted personnel. Non-emergent and elective surgeries were scheduled to challenge the system and ensure adequate supplies were available for anticipated casualties. While the DEPMEDS were well stocked, some equipment was lacking, such as pulse oximeters for the intensive care units and various types of orthopedic equipment such as external fixators. These equipment shortfalls were resolved prior to the ground war and few resupply issues were encountered despite the lack of a full-time logistician for the hospital. My command emphasis was centered on equipment, training, morale, and force protection posture. Overall, the discipline of all soldiers was excellent – no weapons or sensitive equipment were lost. More importantly, there were no fatalities and only one soldier was evacuated due

to injury. One of my highest priorities was to keep the staff informed of the situation in the theater and the progress of both the air and ground wars.

From a medical standpoint, the delivery of care was first-rate the entire time the hospital was operational, from 31 January to 8 April 1991. Overall, there were approximately 1,000 patients admitted and 500 procedures performed by the surgical staff. An excellent example of our capability was the third surgery performed soon after the hospital became operational. It involved a 16-hour vascular repair of an accidental self-inflicted gunshot wound to the leg. Once the ground war kicked off on 24 February, the flow of patients in and out of the hospital was fairly constant for the next several weeks. At no time were all the operating rooms in use and the maximum number of occupied beds at our busiest time was 160 patients. This was mostly due to the prompt evacuation of casualties once they were stabilized. The majority of patients evacuated to us during this time were enemy prisoners of war who primarily had minor extremity injuries and shrapnel wounds. Several weeks after the conclusion of the ground war, Iraqi civilian casualties were brought in who had been attacked by their own military helicopters to quell an uprising. This group included mostly women and numerous pediatric cases. Assistance for these patients came from physicians and nurses from the 10th MASH. We were, by far, the busiest evacuation hospital in the 62d Medical Group due to our easternmost location. As the 18th Airborne Corps moved eastward, we became the closest hospital for helicopter air evacuation missions. Without a doubt, we definitely proved that our medical capabilities were nothing short of excellent.

With the termination of the ground war and the subsequent redeployment of the 18th Airborne Corps back to the United States, the 15th Evac Hospital finally shut its doors on 10 April. Hospital personnel moved back to Dhahran and boarded aircraft for Fort Polk on 24 April. In retrospect, the hospital performed well above expectations and I was extremely proud of their efforts. It was a tremendous honor to have served as the commander of the 15th Evac Hospital during the Gulf War. My two main objectives were to provide the best medical care possible and get everyone back alive; both of these were met and exceeded. I had high expectations of my soldiers and they performed like the professionals they are.

The AMEDD met the challenge of providing state-of-the-art medical care during Operations Desert Shield/Storm. In this current time of national crisis, as we gear up for dealing with terrorists worldwide, are we ready for the next major deployment? I feel that PROFIS personnel are even better prepared now, due to improvements in our Officer Basic and Advanced Courses. In addition, the current rotation schedules to NTC, JRTC, Bosnia, and Kosovo give physicians and nurses more exposure to the DEPMEDS environment and the problems associated with providing medical care in a field setting. While DEPMEDS has been a big leap forward since the days of the Vietnam War, my biggest concern now is the lack of

keeping pace with technological changes and the current practice of medicine (for example, portable ultrasound, magnetic resonance imaging, and laparoscopic equipment). Despite these challenges, the AMEDD can, and will, adapt to the changing requirements of the 21st century Army and will provide the best medical care for every soldier during any conflict, regardless of location or conditions. We practice good medicine in bad places.

AUTHOR:

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15th Evacuation Hospital

Adaptation of Medical Personnel to Combat

COL (Ret) Cynthia A. Gurney, AN, USA†

One of the reasons soldiers are willing to expose themselves to enemy fire is that they know excellent medical resources are available if they become injured. Those medical resources can be rendered ineffective if medical personnel are paralyzed by fear or stress. The purpose of this study was to isolate individual characteristics and organizational policies that enable Army Medical Department (AMEDD) soldiers to adapt more quickly and effectively to deployment. The study consisted of a survey of a stratified random sample of AMEDD personnel deployed to Southwest Asia (SWA) for Operation Desert Shield/Storm (ODS). Major study variables included social support, stress, education/training, experience, attitude about deployment, and biodemographic characteristics. Of 5,000 soldiers selected, 1,310 usable surveys were returned. Data analysis performed included frequencies, principal components factor analysis of scales, psychometric evaluation of scales, and multiple regression analysis to determine relationships among variables.

Introduction

The combat soldier's assurance of expert medical treatment if injured is meaningless if the caretaker is paralyzed by fear, or rendered ineffective by the stress of the new demands placed on them. One of the most potent reasons soldiers are willing to expose themselves to enemy fire is that they know their chances of survival are heightened by the quality and sophistication of the Army's field treatment facilities. Desert Storm offered a critical test of that system. It had the potential to teach us a great deal about how we can prepare our AMEDD soldiers for the next contingency.

Significance of the Problem

In the post-Cold War world, the mission of the military services has turned more and more toward rapid deployment and small unit intervention in support of peacekeeping and humanitarian assistance operations throughout the world. This capability requires rapidly deployable medical support that can hit the ground running with comprehensive medical services in support of ill and injured civilians as well as soldiers. The purpose of this study was to isolate individual characteristics and organizational policies that would enable AMEDD soldiers to adapt more quickly and effectively to deployment and duty in a deployed environment.

During the autumn of 1990 and winter of 1991, 23,493 AMEDD personnel deployed to SWA in support of ODS. By component, approximately 10,935 active duty, 5,746 Army Reserve and 6,812 Army National Guard personnel served in the SWA theater of operations.¹ These soldiers operated 35 Deployable Medical System (DEPMEDS) hospitals and provided host nation support to an additional nine Saudi Arabian facilities. During the war, medical personnel treated 22,000 inpatients and 140,000 outpatients, including more than 800 enemy prisoners of war.²

Although the military prescribes training and policy to prepare Active and Reserve Component (AC/RC) AMEDD soldiers to function in their military role during both peace and war, anecdotal feedback and research data during and following ODS told us that most still experienced great anxiety on deployment. Participants affirmed that they were just not prepared for what they would meet.²⁻⁹

Conceptual Framework/Literature Review

Previous Studies.

There is a wide body of research that relates the impact of stress and the effectiveness of coping to specific psychological and physical outcomes.¹⁰⁻¹⁴ Ryan-Wenger

demonstrated that even in a population of nurses activated but not deployed to the Gulf during ODS, these outcomes were consistent with post-traumatic stress disorder (PTSD).⁷ To the military planner, it is an important next step to recognize the impact of these psychological/physical outcomes on effectiveness in the field, for the caregiver as well as the foot soldier.¹⁵ For caregivers to function effectively, they must think clearly and respond to change quickly and appropriately with enough energy remaining to assist others to do the same. They can only do that if they have effectively adapted to the situation.

Little previous research demonstrates the combination of forces that interact to maximize effective coping and adaptation of medical personnel in combat. Much of the work done following Vietnam related to stress, combat stress, and PTSD was retrospective.^{16,17} Although these authors demonstrated that some soldiers functioned more effectively in a combat environment than others, they lacked the advantage of concurrent research or a focus on predictive factors. The AMEDD achieves the greatest gain by studying those deployed and their experiences as close to the event as possible. This would be the optimal time for the AMEDD to identify immediate problems, recognize issues for further study, and develop strategies to effect change. Ryan-Wenger's study, conducted in three phases during the Gulf War, focused on a small sample of Army Reserve nurses alone.⁷ It did not compare different categories of personnel or personnel from other components of the Army. It also did not describe specific areas for attention identified by the respondents themselves. Studies with larger, more diverse samples were needed before generalizable conclusions supporting policy and training changes could be drawn.

Adaptation.

Adaptation is the degree to which an individual adjusts psychologically, socially, and physiologically to life events.¹⁸ It is a complex concept influenced by both internal and external factors. Roy postulated that a person's level of adaptation is a result of the pooled effects of three classes of stimuli: focal, contextual, and residual (Figure 1).¹⁹ Focal stimuli are those most directly confronting a person. Certainly the experience of being dropped precipitously into a combat theater to provide patient care to ill and injured soldiers was a focal stimulus for the AMEDD

soldiers sent to the desert. Contextual stimuli include such stressors as an unfriendly climate, giving patient care under austere conditions, and the inability to practice routine daily activities or rituals in a customary manner. Contextual stimuli may also be potentially positive forces such as the social support a person gets within their unit or through their circle of friends. Lurking in the background are those residual forces the individual brings to the situation. These may include their age and background, level of experience, and level of military training. Another residual stimulus may be the person's general attitude toward deployment to SWA.

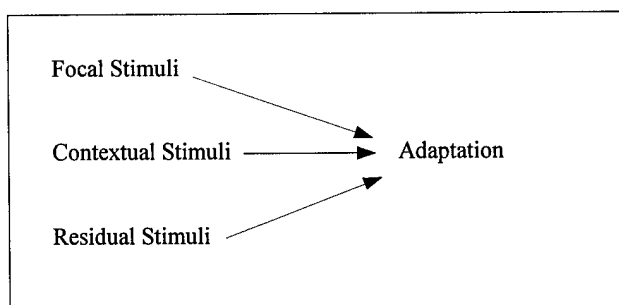


Fig 1. Roy's classes of stimuli.

Roy's Adaptation Model suggests that multiple factors contribute to the individual's ability to adapt and function effectively in combat. To test this, I undertook a comprehensive study of factors related to adaptation to combat. This study measured multiple biodemographic characteristics, experience, education, environmental factors, and social support to test a proposed predictive model of adaptation. The findings could suggest policy strategies to more directly address the needs of the population of AC/RC soldiers who may be deployed. Another anticipated outcome was to identify strategies individuals could independently use to better prepare themselves for combat duty.

Research Questions/Hypotheses

Figure 2 illustrates the proposed model tested. Data analysis assessed the efficacy of this model and tested modifications to it based on the outcomes of statistical analyses. This model states that social support, biodemographic variables, the environment, education/training, and experience each contribute to personal adaptation.

The model assumes summative factors relate linearly

to the dependent, variable adaptation. The research question addressed in this study was: Do biodemographic, environmental, educational, and experiential factors significantly explain AMEDD soldiers' adaptation in the combat environment?

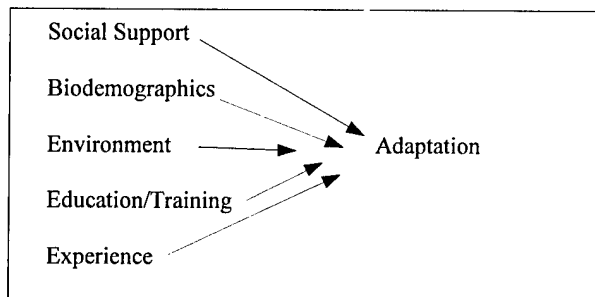


Fig. 2. *Proposed model of adaptation.*

This research is part of a larger study intended to study the interaction effects of social support on ways of coping and adaptation. It also compiled information that examined in detail the benefits and problems associated with DEPMEDS equipment. This research report consists of only a partial analysis of the data. All data are reported in the aggregate with subgroup effects planned for later study.

Assumptions

This research assumed that by the fall of 1991, the Department of the Army's database of soldiers deployed to SWA was reasonably accurate. It further assumed that inaccuracies in data such as addresses or names were distributed equally across groups, thus avoiding systematic error related to service component or occupational specialty. This research also assumes soldiers' recall of events and attitudes 12 months after their return from the war reasonably reflected truth. The elapsed time would be sufficient to allow reappraisal, which appropriately balanced emotion and reason without sacrificing accuracy.

Limitations

The special problems of conducting research during war imposed several limitations on this study. Originally designed to be conducted during the build-up to war and the war itself, delays related to organizational approval and obtaining a sample forced a mail survey design and pushed data collection to the winter and spring of 1992. Also,

because the theater commander forbade research in theater, only a very select few were able to obtain permission to carry out their studies. In order to conduct the study after the troops returned from SWA, mail questionnaires were necessary. Although Department of the Army directed the Total Army Personnel Command (PERSCOM) to create a central database of military personnel stationed in SWA during ODS, this database was not ready to be tapped until December 1991. Errors in the database required multiple corrective strategies during data collection. These are recounted later.

To be approved, this study needed to meet organizational needs to explore issues related to equipping medical facilities and personnel readiness. This, and the fact that the Army's mark-sense form is limited to 182 items, necessarily limited the amount of space available for theory testing related to social support, stress, ways of coping, and adaptation. Therefore, scales were modified and shortened to minimize the number of items per scale without sacrificing the scales' psychometric strengths. In all cases, the retained items achieved the highest inter-item/total correlations and strongest factor loading. Preset minimums were assured for these scales at all times. Scales constructed for the purposes of this study related to this deployment experience did not meet the same psychometric standards, as this was their first test.

Research Methodology

Instrumentation.

This study utilized multiple scales for theory testing, adapting portions of pre-existing scales that were well tested and reported in the research literature. Nurses and researchers familiar with the content area studied, and others experienced in military service under combat conditions, contributed to tool construction. To obtain the support and official sanction of the Office of The Surgeon General (OTSG) and the Soldier Support Center of the Army Research Institute, the survey underwent exhaustive review and staffing. Between January and March, the tool was piloted to AMEDD personnel who were returned to Walter Reed Army Medical Center for medical treatment. These Gulf veterans offered comments which enhanced the physical presentation of the questions, their clarity, and helped eliminate redundancies.

The study employed a 182-item questionnaire. Items addressed the individual's military and civilian education level, experience in combat medicine, biodemographic parameters, and their deployed work environment. The format of the survey allowed respondents to use DA Form 3421-1 (a mark sense form) for their answers. Open-ended questions to be completed in the booklet enhanced data collection by allowing the respondent to provide additional information not elicited in the survey.

Listed below are the scales used to measure four major constructs:

- *Social Support Index*. Adapted from the Family Stress, Coping and Health Project, conducted at the University of Wisconsin-Madison, this 17-item inventory was previously tested on a military population demonstrating acceptable reliability ($\text{Alpha}=.82$) and validity when correlated with the criterion of family well-being ($r=.40$).¹⁴ It addresses esteem and emotional and network support of family members and community. For purposes of this study, items related to family alone were excluded. The resulting six items provide a measure of community support. In this case, the community was defined as the soldier's deployed unit.

- *Stress Scale*. This scale was adapted from the Nursing Stress Scale developed by Gray-Toft and Anderson.²⁰ The original scale contained 34 items that subdivided into seven factors. These seven factors were death and dying, conflict with physicians, inadequate preparation, lack of support, conflict with other nurses, workload, and uncertainty concerning treatment. In a test of 122 nurses, the scale demonstrated test-retest reliability of 0.81. Spearman-Brown, Guttman split-half, coefficient Alpha, and standardized item alpha measures of reliability all fell between .79 and .89. Modification of the scale for this study shortened it by limiting each factor to four or five measures and requiring that those measures included held the highest factor loading and met preset minimum requirements (greater than 0.40) for factor loading. The resulting 26 items carried an average factor loading of 0.6. In addition, rewording items to make them applicable to any member of the health care team modified the scale. As an example, items were modified to reflect conflict with "coworkers" rather than "other nurses." Conflict with physicians may be reflected as conflict with "other persons

with more authority than I." Final modifications adapted the scale to the deployed environment since it was hypothesized stresses that arose due to the field environment could be an important factor in the individual's overall stress level. Since no existing scale measured that, added items addressed uncomfortable living arrangements, inadequate rest, poor food quality, inadequate facilities for personal hygiene, lack of privacy, lack of communication with family, fear for personal safety, and the inability to continue usual religious practices.

- *Ways of Coping*. Developed originally as the Ways of Coping Index, this scale describes the coping process for a particular stressful encounter.¹² Contained in the questionnaire used for this study, it was not included in this preliminary analysis of the research data and will not be reported further.

- *Member Well-Being*. The member well-being scale represents a measure of adjustment and adaptation. Adapted from the Family Member Well-being scale used in the Family Stress, Coping and Health Project, this scale demonstrated reliability ($\text{Alpha}=.86$).²¹ It was also tested on a military population and addresses adjustment in terms of concern about health, tension, energy, cheerfulness, fear, anger, sadness, and general concern. The total 8-item scale was used.

Table 1 lists additional explanatory variables that combine to describe focal, residual, and contextual factors that influence perceived well-being. Where possible, multiple-item scales were constructed to describe these factors with reliabilities reported later. The service member's attitude related to their deployment was measured along a 6-point continuum, which ranged from "I was strongly against...and tried to avoid," to "I wanted to go so much I took steps to assure I would go."

Sample.

The target population was AMEDD soldiers stationed in SWA during ODS. The sample required a minimum of 1,300 soldiers chosen by stratified, randomized sampling techniques. Stratification by Corps was necessary to ensure representation of all specialties (MC, AN, AMSC, etc) Enlisted soldiers were sampled as

Biodemographic variables	
Time in service Corps/Specialty	Total years member had toward retirement at the time of deployment (1) Corps for officers, Military Occupational Specialty for enlisted (1)
Age	Age at last birthday (1)
Sex	Gender, male, or female (1)
Military status	AC/RC, Federal Civil Service, Civilian (1)
Service	Branch of the military (1)
Rank	Military rank E-1 through O-10 (1)
Comfort in role Family disruption	How well prepared they felt in their deployed role and with their military skills (2) Difficulty of making arrangements for care for children and/or adult dependents at home and whether those dependents needed to be relocated to get care. (2)
Number of dependents Financial hardship	Number of children and/or adult dependents at home (2) Magnitude of decrease in annual income or entitlements due to activation and deployment and unreimbursable expenses (5)
Willingness to serve	Attitude of service member regarding being assigned to duty in SWA (1)
Education and training variables	
Education level Trauma care training	Highest civilian and military education (2) Amount of specialty training in trauma care such as the Combat Casualty Care Course, Advanced Trauma Life Support, or Emergency Medical Technician training, intensive care, or battlefield medicine training (5)
Experience variables	
Experience Field training	Experience in career field Participation in field exercises as part of a field hospital or as a combat medic on a range from no experience to greater than 20 days (1)
Previous deployments	Deployment for named operations such as Operation Just Cause, Lebanon, Urgent Fury, Vietnam (2)
This deployment experience	
Preparation	Service member's assessment of their preparedness in the areas of clothing and equipment, family affairs, financial affairs, and military training (4)
Problems becoming operational	The problems the unit experienced becoming operational related to transportation delays, missing or inoperable equipment, training and availability of personnel, leadership, and mission orders (8)
Symptom distress	Whether the service member experienced an increase in their physical complaints or anxiety during deployment (2)
Satisfaction with deployment job	On a continuum, whether service member was enthusiastic about their job, liked their job better than the average worker, or were satisfied with their job while deployed (3)

Table 1. Variable Definitions (Number of Items)

one group. This minimum sample size met the assumptions to secure a power of 0.80 with 32 variables. A confidence level of 0.05 was preset. This sample size ensured the study would have the ability to identify significant direct effects of 0.02 to explain the variance

(R^2) in adaptation.²²

Although 1,300 was the minimal acceptable sample size, the largest sample obtainable was desired due to the wealth of additional independent variables that could

emerge during correlation analysis. The PERSCOM database was not available until late December 1991. Using this database, the sample was pulled according to the prescribed sampling plan which included randomization within specialties, in the numbers desired, and produced a report in the form of mailing labels. Since these labels provided the individual's unit address, the population was grossly over-sampled to accommodate respondents lost to study due to wrong or inadequate addresses. A total of 5,000 were sampled.

Data Collection.

Questionnaire packets included the survey, a Department of the Army Form 3421-1 scan sheet, a cover letter from the OTSG's Director of Personnel explaining the purpose of the study, and a franked return envelope. The packet also included a franked postcard addressed to the Principal Investigator (PI) which could be returned separately by the respondent to request a copy of the executive summary of the study's results.

Following formal scientific and human subjects review and approval, the researcher distributed the questionnaires by mail. A postcard followed 1 week after the surveys went out, describing the purpose of the study, urging the soldiers' support, and giving them a number to call if they did not receive, or had misplaced the questionnaire. Two weeks later, a second postcard was mailed urging the subjects' support and encouraging them to contact the researcher if they needed another survey. These methods are consistent with Dillman's protocol for ensuring good response rates.²³

The survey was fielded between December 1991 and March 1992. Packets returned "not deliverable" were sorted by like addresses and units originating at or near those addresses were contacted to locate the correct unit addresses for these individuals. When possible, packets were remailed to the individuals when new addresses became available. Many members of the sample called the PI to report that they had received the postcard but not the larger envelope with the questionnaire. In each case, the packet was reforwarded to a better address for that individual. Over 700 questionnaires were remailed to new addresses. Despite these efforts, over 1,000 questionnaires could not be forwarded. Data collection continued through

the summer of 1992 and was finally closed in October.

Description of the Sample.

Table 2 illustrates the study sample. The table also reports the proportion of that characteristic in the population where known. Percentages may not add to 100 due to rounding effects.

	Sample	Total Deployed
Military Status		
Active Duty	723 (55.2%)	10,935 (46.5%)
Reserve Component	555 (42.4%)	12,558 (53.5%)
Missing	32 (.02%)	
Total	1310	23,493
Gender		
Male	906 (69.2%)	
Female	388 (29.6%)	
Missing	16 (1.2%)	
Marital Status		
Single/Never Married	255 (19.5%)	
Married	890 (67.9%)	
Separated/Divorced	137 (10.5%)	
Widowed	5 (.004%)	
Missing	20 (1.4%)	
Rank		
Enlisted	583 (44.5%)	18,011 (76.7%)
Warrant	15 (.01%)	182 (.007%)
Officer	707 (54%)	5,300 (22.6%)
Missing	5 (.004%)	
Total	1310	23,493

Table 2. Description of the Sample

Data Analysis Procedures and Findings

Descriptive analyses of sample characteristics are reported in Table 2. All item frequencies were analyzed to diagnose and correct problems related to coding, data entry, and missing data. Each scale in its modified configuration underwent internal consistency testing using Cronbach's Alpha. Prior to that, the stress scale was factor analyzed using principal components factor analysis to detect differences from the original seven scales of the Gray-Toft and Anderson work. For this study, the modified scale with its eight additional items related to the environment in the Gulf factored into four clear subscales. These were patient care, environment, conflict, and death

and dying. Five items were discarded when they did not fall into any of the defined factors. Table 3 reports the reliability data for the three modified scales and the four subscales of stress.

Scale	Number of Items	Reliability
Social Support	6	0.80
Stress	27	0.88
Patient care	10	0.82
Environment	7	0.80
Conflict	5	0.77
Death/Dying	5	0.71
Member Well-Being (Adaptation)	8	0.75

Table 3. Internal Consistency Reliabilities of Scales

Additional variables listed in Table 1 constructed for the purposes of this study were also subjected to psychometric testing and are reported in Table 4. Items not listed below entered the equation as individual items.

Scale	Number of Items	Reliability
Satisfaction with job while deployed	3	.85
Problems becoming operational	8	.88
Training	7	.59
Experience	7	.53
Family disruption	4	.69
Financial hardship	5	.56
Preparation	4	.66
Symptom distress (physical/emotional complaints)	2	.52

Table 4. Internal Consistency Reliabilities of Explanatory Variables

Once the scales' psychometric stability was established, analysis focused on predicting adaptation using preliminary linear regression for causal modeling. Causal modeling allows the investigator to use multiple independent variables to infer cause. It enables the researcher to employ existing theory to construct a tentative model and then through systematic multiple regression analysis, construct a causal model for the construct. The basic requirements are that the independent variables precede the dependent variable in time, posited

theory supports the notion of a causal effect, and change in the value of the independent variable(s) is accompanied by change in the value of the dependent variable.²⁴

The variables included in Figure 3 demonstrated significant direct effects on adaptation, as represented by the scale, for member well-being. The effects reflect the standardized Beta (β).

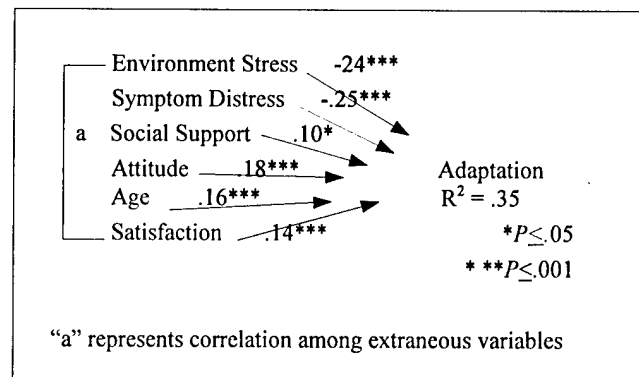


Fig 3. Significant direct effects on adaptation (β).

These data indicate two variables (environmental stress and symptom distress) profoundly and negatively contributed to the explained variance in adaptation. The greater the individual's reported environmental stress and symptom distress, the less likely they were to respond to the survey in a way that reflected good adaptation to their combat situation. On the other hand, strong social support within the unit and greater satisfaction with their deployed role were associated with greater adaptation. Age and positive feelings about being deployed to the Gulf also supported adaptation.

To examine the stress scale as a whole rather than its individual subscales necessarily sacrifices some of its explanatory value. By entering each subscale of stress independently, one is able to isolate the strongest predictor of adaptation – in this case – the environment. It is also interesting to note the consistency between the findings of the regression analysis and the mean scores for stress. Examining only the descriptive data for stress indicates that the greatest sources of stress for this group were in the environmental variables. "Privacy" (sample mean=2.7), "living arrangements" (2.6), "food" (2.6), "facilities for personal hygiene" (2.5), and "inadequate rest" (2.3) carried the highest mean scores for stress on a scale from 1 to 4. On the other hand, the "death of a patient I knew" (1.1),

“talking with a patient about death” (1.2), “floating to other units” (1.4), “inability to continue usual religious practices” (1.4), and “the death of a patient I didn’t know” (1.4) were the least stressful items to the sample. Conspicuously absent from the predictors of adaptation equation were the variables listed in Table 5. All of these variables failed to significantly contribute to the explained variance in adaptation.

- Military status (AC/RC)
- Marital status
- The other three stress factors (patient care, conflict, death and dying)
- Problems with DEPMEDS equipment (although these variables were significantly correlated with stress as a whole)
- Experience
- Years in service
- Financial hardship
- Gender
- Training
- Grade
- Family disruption

Table 5. Factors that did not Predict Adaptation

Discussion and Implications

The study’s sample represents proportionally fewer enlisted and more active duty personnel than the general population deployed to SWA. This may reflect the difficulty in getting accurate addresses for individuals and units. Enlisted medics deployed with combat units were more difficult to trace. Even so, 20% of the sample reported they were deployed at the Medical Company, Battalion Aid Station, or Tactical Unit level. Similarly, active duty personnel were easier to find since they remained accessible through their military unit address. Despite these differences, the large sample in this study warrants continued analysis. Military status, operationalized as AC/RC, failed to demonstrate any significant effect on the outcome variable-adaptation. There was also no significant correlation between military status and any of the stress variables.

These data support the theory of a combined effect of focal, contextual, and residual stimuli. If service in the Gulf is the focal stimulus, environmental stress, social support and symptom distress could be considered contextual

stimuli. Attitudes toward deploying, age, and satisfaction with their deployed role fit the model as residual stimuli.

Environmental stress was one of the predominant predictors of adaptation and it was also among the top five identified stressors in this sample. Lowest on the stressor continuum were patient care variables. This may speak to our medical personnel’s functional ability or adaptation to patient care in combat. Patient care issues, conflict, death and dying are a normal part of their working agenda. They are experienced in dealing with these on a daily basis and when deployed, perceive the least amount of stress from these concerns. They have been able to generalize the mechanisms they normally employ to cope with these issues, to the combat scenario. The one unknown of the stress factors for this sample was environment. Day-to-day practice in a fixed facility at home did not prepare AMEDD personnel for heat, dust, or lack of privacy, and it had a negative impact. They complain about the artificial situations created when they train in the field. These data demonstrate the usefulness of this training if it sensitizes the individual to the hardships of life in the field and offers them opportunities to develop strategies to adapt to it before they are precipitously dropped into it.

Symptom distress, operationalized here as an increase in physical complaints and anxiety, was associated with lower levels of adaptation. One could argue the time relationship between adaptation and symptom distress. Do increases in somatic complaints decrease adaptation? Or does poor adaptation lead to increased complaints (Figure 4)? Stress has long been linked to illness.²⁵ Failure to cope effectively with stress, failure to adequately adapt, leads to biochemical alterations which can cause disease and has sprouted a new field of study termed psychoneuroimmunology. The demonstrated association between symptom distress and adaptation emphasizes the need for medical personnel to be cognizant of this relationship and alert to the needs of their own personnel, as well as those of the casualties they receive. Future tests should address a nonrecursive model – one that looks at a reciprocal relationship between symptoms and adaptation.

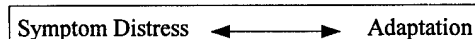


Fig 4. Potential model for symptom distress.

The fact that social support contributed to adaptation supports current efforts to deploy units as a whole. When deployed as a unit, a sense of community and mutual trust places that unit far ahead of other units assigned piecemeal. Those who served in Vietnam can testify to the fact that when units are deployed in pieces, much time is lost forging relationships and building the social support systems that will carry that unit through adversity. Many units fail entirely. Combat stress teams are also becoming a more common part of the mobilization inventory. They direct their attention jointly to combat casualties and to the units caring for them.

It is intuitively logical that the individual's initial reaction to deployment, their age, and satisfaction with their deployed work would shape their ultimate adaptation. All leaders would much rather take with them mature clinicians who want to be there, than those who don't. The mobilization scenario does not always give leaders that choice. Perhaps leaders can devise creative strategies that empower them to exercise that flexibility. Or more importantly, perhaps leaders need to learn techniques that will build not only their personnel's military and clinical skills, but also the mindset or spirit that prepares them psychologically in advance for this contingency.

One of the most disturbing findings, or rather absence of findings, is the lack of demonstrable association between training, experience, and adaptation. Intuitively, one would guess that soldier medics who served in Vietnam, in Grenada, or saw action during Operation Just Cause would find that experience prepared them to adapt in yet another wartime scenario. These data do not support that. It is possible that the number of subjects with that experience were too small to show a relationship. Experience was treated as a summative variable combining those with experience in Vietnam ($n=107$), Central America ($n=106$), Grenada and Just Cause ($n=47$), Operations Baby Lift/New Life ($n=19$), and Hospital Ship Mercy ($n=19$). It could be that the experiences in these different scenarios differed too much to combine them into a single construct defining "operational experience." Anecdotal accounts from the Gulf War indicate Vietnam veterans had a much more difficult time adjusting to war in the Gulf than expected. Their experience was 20+ years earlier in a much different war, laden with negative baggage. Recent experiences in Central America were

much different, in an Army blessed by much more solid support from the American public. Future work with these data needs to examine how these variables are operationally defined and to explore alternative configurations of the data to determine if the construct can be better articulated and tested.

Likewise, training needs further examination to determine if it is the manner in which it is operationalized that is undermining its ability to predict outcomes. At this point, it is too early to categorically deny the importance of training and experience to outcomes. Correlations involving adaptation demonstrated significant binomial relationships with officer military education ($P \leq .001$), enlisted military education ($P \leq .05$), field training ($P \leq .01$), and the individual's perception of being prepared for their deployed clinical role ($P \leq .001$) and deployed military role ($P \leq .001$). These data are rich with information; there is much work yet to be done to explore it.

Recommendations

Future analyses should examine the connection between stress and the individual's way of coping (Figure 5). It will examine the role of social support as an interaction variable projecting that it may mediate the impact of stress on coping and adaptation. Subgroup differences by military status, gender, or occupational specialty may indicate the specific needs of different groups of individuals with implications for training.

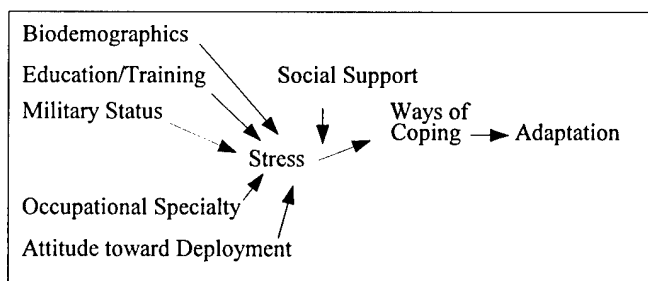


Fig 5. Adaptation model for future testing.

Conclusions

Since the Revolutionary War, we've supported American soldiers in battle. Each new generation has responded and faced the challenge. Today's AMEDD will continue to be called to respond to that challenge. The current world situation suggests multiple small unit

deployments for peacekeeping and humanitarian assistance operations will tap proportionally more of the AMEDD for longer, and more austere activities. Fewer creature comforts and more severe Third World environments will be the order of the day. The AMEDD cannot risk mission failure because its personnel were not prepared for the stress of the environment. Realistic training simulations along with shared lessons learned could address this need. "Surviving deployment" in a very personal sense should be a part of every facility's annual training cycle. Those who have been through it should share tips and pitfalls, the good and the bad, to sensitize the next generation of caregivers.

The role of leadership in building an effective social support system cannot be stressed too heavily. Med Force 2000 doctrine includes a system of caretaker hospitals. In this doctrine, except for a small cadre, the entire professional and enlisted staff of a deployed hospital issue from a single fixed facility. These fillers train together, work together, plan together, and occasionally socialize to assure that when deployed, they deploy into a situation which boasts a strong, well-established social support system. These data support this concept. Leadership can use this system of social support to mold positive attitudes toward deployment and confidence in the role the individual plays when deployed.

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Through the Eyes of the Medic

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Most reports from the Gulf War have been quantitative research studies or anecdotal accounts of personal experiences. This study represents an aggregation of a large data set of qualitative correspondence that occurred incidental to a larger quantitative study. The research questions guiding this analysis were "What was the experience of military medical personnel deployed during Desert Storm?" and "What were the issues identified by these personnel that could impact future deployments?" This article represents a secondary analysis of qualitative data contained on 543 surveys of enlisted personnel returned as part of a study of adaptation to combat. Using content analysis, major themes identified from the data were categorized to reflect pre-deployment, arrival, deployment, post-deployment issues, and important issues needing resolution before the urgency of conflict or rapid deployment.

While Operation Desert Storm/Shield (ODS) occurred over 10 years ago, we can still learn important lessons from the experience. Between August 1990 and March 1991, massive build-ups of troops took place that included medical department personnel from all three services. Active and Reserve Component (AC/RC), single, and married; new and experienced personnel alike received the call to the Gulf for one of the largest and most rapid build-up of troops in history. Since Vietnam, military medical forces have provided small, short-term support for conflicts such as Operation Just Cause and Operation Urgent Fury. Since ODS, the U.S. has returned to mainly time-limited periods of support to resolve conflicts or for humanitarian missions, averting the need for large-scale operations the size of ODS. While the actual period of conflict fortunately was short, the process of deploying such a large number of personnel and setting up to support what could have been an extended intense conflict yielded some important information regarding capabilities and challenges which need to be addressed to insure success in future situations.

From December 1991 to March 1992, 5,000 surveys were mailed to military medical personnel, both AC/RC enlisted and officers, to identify individual and organizational characteristics that enable medical personnel to adapt more quickly and effectively to duty in a combat environment. The Institutional Review Board at

Walter Reed Army Medical Center approved the project. The survey included 182 multiple choice items derived from established scales of stress, coping, social support, and member well being with the purpose of constructing a causal model of adaptation to combat. As part of this survey, 10 questions included an option for an open-ended response and a final comments section concluded the survey. This study represents a secondary qualitative analysis of existing data from the larger study of deployed military medical personnel. The research questions guiding this analysis were "What was the experience of military medical personnel deployed during Desert Storm?" and "What were the issues identified by these personnel that could impact future deployments?" The mission of military medical departments is to support and protect the fighting force. If energy and efforts are being directed elsewhere, as for example, in personnel or equipment issues, the prime mission of the medical department is not being met and our position of strength eroded. The significance of this study rests in the identification and potential resolution of issues *before* the urgency of conflict or rapid deployment.

Methods

In December 1991, 2,500 enlisted and 2,500 officers were randomly selected from a DOD-provided list of Gulf War veterans. The sample was stratified by corps to

ensure inclusion of all specialties (physicians, nurses, allied health personnel, medical administrators, and para-professional enlisted personnel). From an effective sample size of 4,300 (700 were nondeliverable), 1310 usable questionnaires were returned (30.5%). The enlisted response rate included 583 surveys and out of these, 543 included written comments. The remaining surveys of the officer personnel have been transcribed and are still in the process of analysis. This article will report the data from the analysis of the enlisted paraprofessional personnel only.

During the summer 1996, a research team consisting of 10 Nurse Corps officers began the process of transcribing the mostly handwritten comments into a word processing program. In order to ensure accuracy in transcription, a 100% recheck compared the original comments to the transcription by pairing a transcriber with another team member who served as reviewer. Once the data were entered, each survey's responses were saved as separate files and then imported into the text-based analysis program, *Ethnograph 4.0*.¹ A subset of the research group consisting of five Nurse Corps officers, most prepared at the master's or doctoral level, began coding the data. During development of the codebook, the coding team met several times to compare accuracy and agreement in the identification and labeling of codes and achieved 90% inter-coder agreement. The team consisted of two nurses with strong qualitative research experience and psychosocial background and three other nurses who had more experience with deployment and field nursing. Each subgroup brought a distinctive "read" and interpretation of the data. To counterbalance this effect and to capitalize on this expertise, both a field nursing expert and a qualitative/psychosocial expert coded each transcription.

Analysis

The team used content analysis as described by Miles and Huberman (1994) for the first and second cut coding of the data. Initial coding followed the content area of the open-ended questions. For example, sample questions included: "What was the most stressful event for you during deployment?" "What additional training did you need?" and "What problems did your unit need to overcome to become operational?" The 10 open-ended questions provided the initial themes that emerged. Each

of these questions was coded intact for the question; additional codes and themes emerged within these questions and the comments section. With the completion of a second, more in-depth analysis, 94 separate codes were clustered under over-riding themes. Descriptive statistics in the form of primarily frequency counts were used to quantify the magnitude of various codes and subcodes where applicable. The original demographic data compiled from the survey data were also analyzed using descriptive statistics.

Sample Characteristics

Most of the enlisted respondents were Reservists (see Table 1). The discrepancy in response rate between AC/RC was most probably due to rotation of active duty soldiers who were more likely to have been reassigned upon returning from deployment. Most were E4-E6, but with some representation for senior enlisted ranks (see Table 2). Experience levels mirrored the rank to some degree (see Table 3). Most were married, which probably contributed to the number of comments regarding family disruption and financial hardships seen in both the qualitative and quantitative findings (see Table 4). Not unexpectedly, most were male (see Table 5) and under 35 years of age (see Table 6).

Active Component	76 (13%)
Reserve Component	498 (85.4%)
Missing	9 (1.6%)

Table 1. Military Component of Enlisted Respondents

E3	23 (3.9%)
E4	193 (33.1%)
E5	168 (28.8%)
E6	117 (20.1%)
E7	63 (10.8%)
E8	14 (2.4%)
E9	5 (.9%)

Table 2. Rank of Enlisted Respondents

1-5 years	255 (43.7%)
6-10 years	150 (25.7%)
11-15 years	106 (18.2%)
16-20 years	51 (8.7%)
>20 years	18 (3.1%)

Table 3. Years of Experience in Career of Enlisted Respondents

Single	151 (25.9%)
Married	365 (62.6%)
Divorced	45 (7.7%)
Separated	11 (1.9%)

Table 4. Marital Status of Enlisted Respondents

Male	436 (74.8%)
Females	141 (24.2%)

Table 5. Gender of Enlisted Respondents

17-24 years	158 (27.1%)
25-29 years	164 (28.2%)
30-34 years	119 (20.4%)
35-39 years	75 (12.9%)
40-49 years	61 (10.5%)
>50 years	4 (.7%)
Missing	2 (.3%)

Table 6. Age of Enlisted Respondents

Findings and Discussion

Once analyzed, the codes seemed to cluster into natural time periods to reflect pre-deployment, initial on-the-ground arrival in theater, deployment, and post-deployment issues. Qualitative data analysis should speak with the voice of the respondent.² Therefore, where appropriate, verbatim comments from participants are used to illustrate particular codes or issues. This study is limited in that every survey did not contain written responses to every open-ended question. Therefore, some skew may be evident in that only those issues which may have been perceived as extremely negative or positive may have warranted a response by an individual. Caution is indicated in interpreting the importance of an issue based upon the volume or lack of volume of response for some issues. Where noted, the frequency of the response reflecting a particular theme is indicated parenthetically as (n=xx). Also, since the responses were anonymous, it is possible that some issues were attached to specific units, as for example, problems with leadership. The findings, however

can be important and useful in describing the overall experience as well as tracking some emerging issues common to the entire experience.

Pre-Deployment Issues

"We were all basically prepared for any situation." "Our unit was fortunate enough to have had a peacetime commander who let us train as we were to fight. Honestly, our unit was ready and adapted quickly when needed..." These quotes represent those who deployed with positive perspectives of their unit and individual readiness to deploy. Indeed, many felt well prepared either from prior experience or from training; others didn't feel as prepared as they would have liked. An example of this type of sentiment was expressed by one medic, "(I would have liked) maybe a little more time to prepare, but I'm not sure anything would've helped make it any easier." The code "leaving home" included the difficulty respondents related in separating from family, going into the unknown of the situation and not knowing how long they would be gone,

and the dangers they would face (n=82). These feelings were reflected in comments such as "(it was stressful) being away from my family; not knowing if I would ever see them again" and "I didn't encounter a lot of stress except for the separation from my family." Other concerns mentioned by respondents included difficulties with family care plans (n=21) and unique problems of dual military and single parents, especially those stationed in Germany and trying to get children back to the states (n=12). Finances were also a concern during pre-deployment, specifically, in getting pay started for Reservists and getting allotments started for family members (n=24).

The wait to deploy seemed to be hard for many (n=36). Respondents mentioned how difficult it was waiting to leave the states and not spending as much time with their family as they would have liked. It was difficult for some dealing with the uncertainty of a deployment date once they were activated or notified of their deployment. One medic objected, "We were told that we would leave in early September. Every couple days we thought we would leave. Not until late November did we actually deploy. If we deploy, deploy us, but don't torment the soldiers." Some felt that the separation was premature in light of the wait to go. "We deployed too early," one person wrote, "Spending 30+ days in a staging area awaiting a location to be selected as a hospital site is simply useless." Many voiced concerns with their ability to cope and described their usual methods of coping. One medic expressed this as "The biggest fear to me upon deployment was the unknown. I had deep feelings that everything would be all right." Pre-deployment respondents mentioned using family support, exercise, and sometimes alcohol to cope with stress.

On the Ground

Once the individuals arrived in theater, different issues emerged. Many complaints were aired about being mixed in with other units as part of the deployment. For example, active duty personnel with reserve (n=52), Professional Officer Filler System (PROFIS) personnel with other units (n=19), or assigning new commanders at the time of deployment (n=12). Again, the waiting seemed to be difficult and emerged again once the respondents arrived in theater. Waiting in this context referred to waiting for equipment to arrive in theater (n=49), waiting

to set up, and then waiting for engagement. Illustrating this theme, one individual noted, "It took 1 month for our vehicles and equipment to arrive in Saudi Arabia. We lacked many drugs and medications which we had to borrow from other units." This represents some other difficulties that emerged with transportation: first, just getting the equipment and supplies in theater and then making it operational in order to mobilize to the site to set up (n=36).

Setting up the unit's site emerged as a separate theme (n=60). Some of the difficulties with set-up surrounded the actual placement of the facility and the environmental conditions under which personnel had to work. "The real problem was fighting the winds while putting up the Deployable Medical System (DEPMEDS) tents. The other problem was our location. We were on a hard rock base that made drainage holes for sinks and grounding rods very, very, difficult to accomplish." This quote seemed to sum up the environmental problems: sand, wind, rock, and weather all acted to make setting up a challenge.

Once on site, preparation was needed in some cases to layout equipment, plan, survey, and then finally setup. Respondents noted that they found that once set up, they often had to breakdown, move, and re-setup at another location in response to changing unit mission or support. This could be quite stressful, as sometimes it was never clear what the reasons were behind the additional work.

In Theater: Issues Throughout the Deployment

Once in the theater of operations, most often in Saudi Arabia, the issues cited by participants sorted out into some over-riding themes. The codes were then organized into issues related to personnel, leadership, unit-related, logistics, clinical and military skills, cultural, or personal concerns. Each of these will be discussed in turn.

Personnel Issues. Unfortunately, racism showed its ugly face throughout the operation. However, only nine individuals reported this. Sexual harassment also was an issue within some of the units (n=25). One individual related, "I thought people would be more professional and a more family-like environment. Instead, married people were sleeping or having sex with other married people. The pressure of, if you do a sexual favor for me, I won't be

so hard on you. Senior leaders taking extreme advantage of their seniority.” Gender issues as well were an issue for some (n=17). One respondent reported, “I strongly feel that female soldiers do not belong in front line or forward support units. Female soldiers are, on the average, not able to physically do what needs to be done to accomplish our mission.” Another individual contradicted this statement noting, “Women functioned better than I thought they would have; (I) would serve with them again.” Another issue involved the perception of a double standard for officer and enlisted personnel (n=15). One medic observed, “Our officers expected and had enlisted setup their tents while they ran around in civilian clothes and did as they pleased. It was not a big morale booster nor did it make for cohesive relationships.”

Quite a bit of discussion revolved around mixing Active Duty and RC personnel to create new units, bringing PROFIS personnel in as fillers, or being placed in unfamiliar units than those the individual had trained with. “I personally feel that the worst thing you can do is mix Active Duty and National Guard/RC forces together in a situation like this” and “We would setup and get a feeling of acceptance then be swapped out with another group. Then I’d feel like a stepchild moving from one family to another” were examples of typical comments. Most individuals noted that these situations affected unit cohesion and productivity in many instances and suggested increased training together during peacetime might help to integrate personnel more effectively.

Unit Concerns. References to issues in this area of concern regarded internal cohesion and operations at the unit level. Many individuals noted the positive aspects of their experience. The team labeled these feelings as “esprit” (n=18) and “unit success” (n=29). “I feel I received a great deal of help from my fellow soldiers. We learned and depended on each other through the ordeal” illustrated one example of unit camaraderie, teamwork, or cohesion. Another commented on the overall functioning of the unit, “The unit came together well, performed in an outstanding manner, and completed our mission. The relationship between the officer and enlisted was excellent. The respect went both ways and the officers were genuinely concerned for the enlisted soldiers.”

Unfortunately, several negatives were expressed

regarding communication (n=62) and organization (n=13) at the unit level. Respondents desired more or better contact with their families and within the unit. They described general communication problems related to getting information about what was going on; the lack of or maintenance of communication equipment; and a larger concern with receiving information through channels or from leadership. Many noted the amount of confusion and chaos that seemed imminent throughout the deployment. This often was associated with the communication difficulties and information sharing.

Leadership. Leadership became a separate theme as several codes were identified that related to leader preparation (n=24), training (n=33), and ability (n=213). Respondents wanted to feel a sense of concern from their leaders; that command cared about those under their leadership and for what they were experiencing (n=50). Some felt there was some obvious “ticket punching” occurring to the detriment of the soldier’s welfare and morale. Many wrote that leaders needed to have more training in how to lead troops, especially under wartime conditions. They further noted that the training should specifically include tactics, soldiering skills, and leadership. One respondent noted, “A lot of problems wouldn’t have been problems had our command been better trained.”

Respondents wanted to see leaders displaying confidence in their abilities and consistency and purpose to their mission or task. “My most stressful events were my leaders each wanting different tasks accomplished and not really knowing or doing what the mission called for” expressed one frustrated medic. Respondents valued an ability to enforce and keep discipline within the unit (n=11). “Standards were obsolete and ignored and this created an environment where there was no respect, morals, or ethics.” Overall, respondents felt command should set the example.

Logistics. Equipment, supplies, transportation, and maintenance codes fell within this category or theme. Unfortunately most did not comment on what went right, but rather upon the problems encountered in this area. One individual summarized the situation for his unit, “Much of our equipment was lost, inoperable, or simply outdated.” Supplies, similarly, were not readily available.

The missing or shortage items identified included patient care items, medications, documentation forms, and repair parts. Just getting items from place to place appeared to also pose a challenge. Sometimes vehicles themselves were the problem. Some shortages were noted as well as poor condition or maintenance, lack of repair parts, and the need to convert some vehicles for other purposes. The environment posed special problems for maintenance. Besides the difficulty with obtaining spare parts, long distances, hazardous driving over unsurfaced or uneven terrain, heat, and sand played havoc with equipment and vehicles increasing the wear and tear and causing lots of breakdowns.

Clinical and Military Skills. A major criticism from respondents related to this area was the difficulty translating clinical peacetime skills into a wartime environment. Many thought there was a clear need for more realistic, hands-on, advanced training. One respondent expressed this need in the following comment, "We are supposed to be the ones who arrive in the nick of time to save Johnny's best friends' life: and yet we are not getting the required amount of training that will keep us medically confident." In addition to clinical skills, others observed that basic soldiering skills were either lacking or needed refreshing. Table 7 delineates the specific training needs identified by the respondents. One individual wrote, "We must practice what we preach. We must ensure we train as we will fight." Another said, "I was surprised to see such a weakness in basic survival skills. If we can not do the basics right the first time and in a timely manner, we will not have to worry about our missions!" In relation to this same theme, some respondents noted the value of the

deployment in solidifying and increasing their knowledge base. "This trip to Saudi Arabia taught me a lot. It helped me know that there is never enough training for war. It taught me to always be prepared, expect the good things as well as the worst" was the observation of another medic.

Personal Issues. This theme included all the notations about concerns of a personal nature. Individuals wrote about their physical comfort/discomfort, fear (n=37), and contact with their families (n=12). "Comfort" was an all inclusive code that included complaints about the environmental heat/cold (n=25), living in tents (n=17), crowded living conditions with little to no privacy; lack of cots (n=3), lack of water for showers (n=23); poor quality food (n=24); and having to overdress in accordance with local cultural norms (n=3). Many took the discomfort in stride such as one individual who wrote, "We adapted to the food and environment as well as we could and we made the best of things" while others took a more sanguine approach offering suggestions for improvement, "Personal hygiene should become more of an order rather than a convenience for all soldiers."

Many mentioned, "fear" in several different contexts (n=37). Some expressed fear of the unknown or "not knowing if you will live to see another day," while others were more specific. These fears included fear of live fire, scud missiles, or seeing the death of comrades. "Most of the people I talked with had the same feelings as myself. We felt alone and scared" seemed to sum up this emotion.

Being able to stay in contact with family at home meant a lot. Some, however, went on to mention difficulties related to the deployment such as divorces, child management problems, and financial hardships that occurred upon their return (n=14).

During deployment, many noted the new outlets they had to find as usual methods were unavailable. Many found others to talk to, stayed in touch as much as possible with family through mail or phone, or just kept things inside themselves. The team labeled one code "my stress manager" to reflect a wish list of things respondents would have like to have had available. These included more opportunities for rest and relaxation, professional debriefing or psychiatric liaisons on-site, more ability to exercise, and more information available in terms of what

NBC/Chemical	69
Soldier Skills/Hands-on	58
Medical Hands-on Training	48
DEPMEDS/Field Hospital	42
Duty MOS Training	30
ATLS/Trauma	25
ACLS/EFMB/EMT	8

Table 7. Identified Training Needs

was going on and how long things would last.

Post-Deployment: Going Home

Codes falling into this category or theme included some concerns and/or resolution individuals experienced upon their return to the U.S. They mentioned the waiting period in leaving the theater as units were staged back to the states. "Morale seemed to be low after the war was over because we felt that we weren't being told the truth about when we were coming home" reflected the uncertainty and hardship not knowing definite dates of departure. Recognition for contributions in the form of awards also seemed to be a controversial and inequitable issue for some (n=19). Some left feeling unappreciated for their efforts (n=18). "Those who did not perform were awarded as though they were war heroes. Those who did were not awarded appropriately." There was also concern regarding who received the Combat Medic Badge, as not all who were engaged in combat received the medal; only those assigned with an infantry unit were eligible (n=16).

Comments/Debriefing

A secondary coding of the final comments section revealed that many used this section to recommend policy considerations and changes (n=43). Many identified implications for changes in areas such as training, deployment assignments, Active Duty/RC mixtures, and counseling/psychiatric support within theater, leadership training, transportation assets, and family care. Another interesting use was made of the comments section. Secondary coding also revealed that the survey had served a "debriefing" purpose for individuals that may not have had a chance to really express some of their concerns previously (n=21). Several noted that the survey had offered an opportunity to express personal experiences, release stress, and feel that someone cared about what had happened to them. Another question also seemed to serve this purpose. This particular question asked if deployment had been what they expected: A total of 382 responded. Out of this number, 36 had no idea what it would be like; 58 felt the experience had been what they expected; 36 not what they expected; and 12 better than expected. Within this question, many again listed the reasons they had responded the way they had. These included expectations such as: more casualties; a longer period of conflict to be

under fire; more stressful; work harder; better leadership; better conditions; smoother deployment; more organized on the ground, or to get back sooner.

Conclusions and Implications

Most reports from the Gulf War have been quantitative research studies or anecdotal accounts of personal experiences.³⁻¹² This study represents an aggregation of a large data set of qualitative correspondence that occurred incidental to a larger quantitative study. The volume of the comments gave voice to the powerful nature of the deployment experience in that so many took the time to add to what was already a very comprehensive assessment of the experience contained in the extensive survey instrument. The comments and recommendations provided by this group of enlisted paraprofessional personnel provided a persuasive and influential case for changes in the preparation, training, and management of our current medical go-to-war mission and organization. Health care professionals in the Armed Forces, AC/RC, work with paraprofessional personnel on a consistent, if not day-to-day basis. Training, leader mentorship, supply and equipment issues, and unit cohesion can be addressed in the peacetime training environment so that, when called for, a smooth, timely transition can be made into an integrated, tightly running unit. The military health care professionals need to take the responsibility on an individual basis to ensure some of the basic problems these respondents identified are not chronic deficiencies, but one-time problems under unique circumstances. Personal and organizational issues should never again be allowed to stand in the way of, or detract from, the primary mission: supporting the fighting force.

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Population Health and Deployed Forces

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One legacy of the military campaign in the Persian Gulf is the realization that the public health toll of a conflict is not truly known at the time the deployment ends. Apart from the assessment of combat-related deaths or injuries and disease and nonbattle injury (DNBI) at the time of a conflict, concerns regarding delayed health effects may extend the medical mission for many years. Pre-deployment medical threat assessments, and on the ground updates to that assessment may be followed by retrospective and speculative post-deployment threat assessments. By 13 June 1991, when the last U.S. service members who participated returned home, the ground war was considered a victory with the surprisingly low total of 145 service members dying in combat and 225 lives claimed by nonhostile actions.¹ The DNBI rates were also very low in comparison with other conflicts, and the low rates were attributed to successful preventive medicine efforts. Nonetheless, over 60,000 individuals eventually sought evaluation as part of the registry programs open to Persian Gulf veterans and their families.²⁻⁴ Ten years following Operation Desert Shield/Storm, uncertainty remains regarding potential exposures, health risks, and adverse outcomes in the 697,000 deployed U.S. troops.

Somatic complaints such as fatigue, shortness of breath, headache, sleep disturbance, forgetfulness, and impaired concentration have been reported following armed conflicts since the Civil War, but etiology remained largely undefined.⁵ Past wartime deployments have resulted in concerns over specific potential exposures as well. Following the Vietnam War, uncertainty relating to exposure to herbicides ultimately led to the Congressional passage of Public Law 102-4 (the "Agent Orange Act of 1991"). This legislation directed the National Academy of Sciences (NAS) to conduct a comprehensive review and evaluation of scientific and medical information regarding the health effects of exposure to Agent Orange, other herbicides used in Vietnam, and the various chemical

components of these herbicides, including dioxin.⁶ The NAS committee faced considerable issues of cohort reconstruction and dose estimation in the absence of quantified exposure information, as well as difficulties in assessing causality. Ultimately, epidemiological studies were reviewed, and specific health outcomes were assigned to one of four categories of evidence based on "statistical associations," not on causality.

Similarly, following the Persian Gulf War (PGW), the Department of Defense (DOD) and the Department of Veterans' Affairs (DVA) faced basic questions of exposure, outcome, and association. These questions address exposures that were known or possible for the deployed cohort, the potential outcomes of importance that might be associated with such exposures, and the studies and actions undertaken to evaluate these associations. Multiple expert boards and committees have studied PGW veterans and health consequences of service in the Gulf.^{1,3,4,6-11} None have been able to define the medical nature and cause or causes of a Gulf War Syndrome, nor identify any cause and effect relationships between putative exposures and an undefined illness. No case definition has emerged. Both the Institute of Medicine (IOM) and the Presidential Advisory Committee (PAC) noted that the formalized registries established by the DOD and the DVA, which provide free medical evaluation to concerned PGW veterans, served an important purpose but were not designed to answer epidemiological questions.^{3,4,9,10}

The PAC noted that the current scientific evidence did not support a causal link between the symptoms and illnesses reported by PGW veterans and exposures while in the Gulf to pesticides, chemical warfare agents, biological warfare agents, vaccines, pyridostigmine bromide, infectious diseases, depleted uranium, oil well fires and smoke, and petroleum products.³ The PAC determined, however, that the investigation of possible

exposures of troops to chemical and biological agents was "superficial and inadequate." It was noted that very little personalized exposure information was available, and defining relevant control groups and obtaining data for them were very difficult. It was noted that lack of exposure data limited even the most expert and well-funded investigation to identify health outcomes linked to specific exposures or risk factors."¹⁰ The Government Accounting Office (GAO) recommended a re-examination of research emphasis in 1997.¹² They noted that the majority of research focused on the prevalence and cause of Gulf War illnesses, rather than diagnosis, treatment and prevention. "While this epidemiological research will provide descriptive data on veterans' illnesses, methodological problems are likely to prevent researchers from providing precise, accurate, and conclusive answers regarding the causes of veterans' illnesses. Without accurate exposure information, the investment of millions of dollars in further epidemiological research on the risk factors or potential causes for veterans' illnesses may result in little return."¹²

Given that a major limitation of all of the epidemiological studies to date has been the lack of detailed exposure data, every committee reviewing the Persian Gulf conflict has recommended that broad-based exposure and outcome data collection be conducted on all future deployments. The IOM recommended "a single, uniform, continuous and retrievable electronic medical record for each service person. The uniform record should include each relevant health item (including baseline personal risk factors, every inpatient and outpatient medical contact and all health-related interventions)."¹⁰

Progress has been made to move this vision forward. As the DOD Executive Agent for medical surveillance databases and data analysis for deployments, the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) has taken a lead role in the design and execution of the DOD Medical Surveillance capability. Current efforts to date have concentrated on two aspects of Medical Surveillance: a comprehensive health outcome database, known as the Defense Medical Surveillance System (DMSS), and a comprehensive occupational and environmental hazard surveillance effort under the Deployment Environmental Surveillance Program (DESP).

The DMSS is a relational database including data on

all persons serving on active duty in any Service in the military since 1990. The DMSS is operated by the Army Medical Surveillance Activity (AMSA), USACHPPM, and staffed by the three Services. The DMSS receives and integrates standardized data from multiple Service and DOD sources worldwide. The "engine" of the DMSS is a continuously growing relational database of current and historical data related to medical events (for example hospitalizations, outpatient visits, reportable diseases, human immunodeficiency virus, results, health risk appraisals), personal characteristics (for example rank, military occupation, demographic factors), and military experiences (for example, major deployments, assignments) of all Army, Navy, Air Force, and Marine personnel over their military careers. There are now more than 150 million rows of data regarding more than 6.5 million service members in the on-line DMSS database.

In FY00, AMSA assumed the mission for DOD of receiving, tabulating, and archiving all completed pre- and post-deployment survey forms (DD Forms 2795 and 2796). As movement towards a single, continuous, electronic data system continues, concerns regarding complete capture of all medical outcomes (as opposed to self-referral for entry into a registry or symptom-based cluster evaluations) lessens. Improved reporting, capture and analysis of the DNBI rates improves with each deployment. The Theater Medical Information Program (TMIP) was included in Public Law 105-85, the National Defense Authorization Act for Fiscal Year 1998, and identifies the requirement for a system that "assesses the medical condition of members of the armed forces (including members of the Reserve Components) who are deployed outside the U.S." This system must also accurately record medical conditions of members before deployments and any changes in their medical condition during the course of their deployment. The TMIP is designed to address many functional areas to include medical logistics, blood management, medical threat, and intelligence, etc.

With respect to exposure information, the other critical component of the exposure-outcome association question, recommendations have been made as well.^{1,7-11} "The DOD should ensure that military medical preparedness for deployments includes detailed attempts to monitor natural and man-made environmental exposures

and to prepare for rapid response, early investigation and accurate data collection, when possible, on physical and natural environmental exposures that are known or possible in the specific theater of operations."¹⁰ The USACHPPM DESP was established in July 1996 to serve as a single point of contact for deployment occupational and environmental health surveillance issues as part of the Center's Executive Agency for medical surveillance databases and deployment surveillance analysis. This was largely in response to the DOD's increasing concerns, especially since the Gulf War, to the risks posed to U.S. Forces by occupational and environmental hazards. The mission of the DESP is to develop a system capable of providing commanders and other decision makers pertinent information needed to detect, assess, and counter environmental and occupational hazards.

The DESP is staffed by environmental scientists, engineers, health risk assessors, and geographers; and provided matrixed support from occupational medicine physicians, industrial hygienists, entomologists, health physicists, chemists, and epidemiologists assigned to the technical programs throughout the USACHPPM. Extensive deployment occupational and environment health surveillance support is provided by the personnel assigned to the USACHPPM subordinate commands, particularly the USACHPPM-Europe command located in Landstuhl, Germany. The current primary functions of the USACHPPM DESP are the analysis of data and dissemination of information concerning the detection, assessment, and reduction of occupational and environmental hazards and health risks during deployments. The program provides consultative assistance, laboratory analyses, and on-site environmental surveillance to deployed preventive medicine assets to identify, prevent, and reduce potential environmental health risks. Spatial and temporal analysis of potential environmental and occupational exposures and health risks is performed using geographic information systems and integrating this information with health outcome data to identify necessary changes in medical threat assessment, and counter-measures. Finally, archiving of environmental and occupational hazard data collected by deployed units in-theater allows investigations of any future adverse health outcomes following a deployment.

These and other efforts continue to mature to provide

information regarding exposure and outcome on deployments. Interestingly, such data results in a broadening of the concept of operational health support from the recognition and treatment of injury and disease as it occurs, to analyses that occur after samples have been collected, analyzed and archived and evaluated for association with measured outcomes. Ideally, the results of samples and measurements taken on deployments are available in a timely fashion so that preventive measures to reduce exposure can be taken when warranted. Rates of DNBI can be compared to expected, and variances can be investigated shortly after they occur, perhaps with respect to measured exposures. However, the potential also exists to identify sources of exposure for potentially delayed health effects.

Traditional preventive medicine support in deployments assessed and controlled sanitation, pests and vectors, and focused largely on infectious disease threats and recommendations regarding exposure to heat and cold. The outcomes likely to occur if such measures were not taken were largely straightforward and known, and most often, fairly immediate: increased rates of diarrheal or other infectious diseases, heat stroke, frostbite, etc. Water evaluation and treatment largely focused on chlorine disinfection; current approaches including testing water for suite of metals, volatile organics, and other possible contaminants. In the past, soldiers were trained to conduct industrial operations so that hazards were minimized, and appropriate personal protective equipment was worn. Currently, sampling of air and soil is conducted to assess the impact of past and ongoing industrial operations in an area of operations.

It is interesting to note, however, that the ability to measure exposures and ultimately evaluate them with respect to delayed health effects raises some interesting questions. What should be sampled? Air? Water? Soil? How frequently? For which contaminants? To what limit of detection? Ideally, these questions can be resolved utilizing a combination of intelligence, professional judgment, and common sense, but in reality, no specific level of threat has been identified, and the range of possible exposures is broad. For example, Presidential Review Directive 5, (August 1998) directed DOD to "identify and minimize or eliminate the short- and long-term health effects of military service, especially during

deployments (including war) on the physical and mental health of veterans." The IOM continues to consider the documentation and evaluation of low level exposures to be important: "DOD should develop and clearly express an underlying philosophy for hazard protection...When making decisions, commanders should attempt to quantify long-term health effects that any action may have on their troops."¹³ "DOD should designate clear responsibility and accountability for a health risk assessment process encompassing non-battle-related risks and risks from chemical and biological warfare agents (including consideration of toxic industrial chemicals and long-term effects from low level exposures.)"¹⁴ Necessary to this process are clear guidelines appropriate for deployed forces, or a way to assess risk that takes into account competing risks and mission requirements. If samples are analyzed for a variety of possible contaminants, they must be compared to a point of reference. What is considered an acceptable exposure may be debated and is likely scenario and mission specific.

For some hazards, guidance for acceptable levels for occupational exposure exist but may not be applicable for extended work shifts or continuous exposure possible in a deployed setting. Screening levels derived for application in risk assessment to represent "no adverse effect levels" for the general population are not suitable because they are meant to protect sensitive members of the population for lifetime exposures and utilize very conservative assumptions at each step of the derivation. Examples of exceeding such screening levels may be suitable as a basis for determining whether or not a remedial action should be considered, but do not serve as a threshold useful to predict the frequency or magnitude of a health effect. Health effects, if they occur at all, might be subtle and not discernable without specific, tailored, outcome-based medical surveillance, apart from waiting for and tallying specific outcomes. With respect to cancer outcomes, values are derived based on a non-threshold model that may not be appropriate for all hazards. Exceeding a screening level derived to address a cancer end point based on a theoretical model may result in anxiety, and consideration of latency would leave the issue unresolved for many years. In actuality, monitoring on recent deployments has been troubled by a time lag between measurement and available results such that information may not be utilized in a preventive sense to reduce

exposure, but may raise questions with respect to significance and prognostic interpretation for those exposed once reports are written. This raises questions regarding the value of such information for any purpose other than after-the-fact epidemiological analysis, yet the need for such data collection has been espoused by every review committee.^{1,4-8}

For the commander on the ground, this adds complexities to the process of managing competing risks. Army commanders are currently trained to manage risk in accordance with FM 100-14, Risk Management, which applies a probability/severity of outcome matrix to operational hazards, to include health hazards.¹⁶ Obvious catastrophic events such as a release of highly toxic materials would have severe health risks, although the probability of such a release can only be estimated. However, since the most profound preventive action is avoidance, troop locations can be selected with regard to proximity and plume (smoke) direction from industrial facilities. With respect to exposure to low ambient levels of chemicals, health effects may be delayed or produce little obvious and measurable impact on the immediate mission, but the probability of occurrence is high. Even if monitoring information were available immediately, uncertainties relating to actual health impact would make decision-making difficult. One approach adopted by the USACHPPM provides concentrations of chemicals of interest representing high, medium, and low risk for short-term exposure.¹⁷ A companion document is under development to address the more problematic long-term exposures.¹⁸

These documents can be viewed at http://chppm-www.apgea.army.mil/desp/pages/samp_doc/TG230/TG230AMay99.pdf. A major consideration relates to the degree of conservatism to apply to the available toxicological reference values to fit the scenario of long-term exposure of a healthy population on a continuous basis. Appreciated, but not well quantifiable, are issues relating to mixtures of compounds and potentially additive or synergistic effects, interaction with other biologicals such as vaccines and medications and the effects of stress, reduced sleep, and other considerations in a deployed setting.

Given that "complete" and seamless exposure and

outcome data systems come to fruition, will they eliminate or alleviate questions regarding exposure and outcome associations following future deployments? Questions such as addressing whether or not a specific deployed cohort is experiencing statistically significant excesses of certain adverse outcomes would conceivably be answerable. Questions relating to the association of such outcomes with a specific exposure on a deployment may not. Given measurable and measured exposures to a known hazard in the range known to produce health effects in humans, the question should be easy to answer. Given measured concentrations of a broad variety of hazards with unclear, but possible health effects ("gray-zone" concentrations), much more sophisticated methods will be required to evaluate the association. Additionally, such analysis typically requires a great deal of exposure data. The GAO, in its review of Gulf War Illness efforts, stated that "The need for accurate, dose-specific information is particularly critical when low-level or intermittent exposure to drugs, chemicals, or air pollutants is possible. It is important not only to assess the presence or absence of exposure, but to characterize the intensity and duration of the exposure."¹²

This essentially calls for continuous monitoring on a broad range of low-level hazards on deployments, but in actuality, comparable data would be needed on a control population, unless sufficient data are collected on a large enough population with frequent enough outcomes to assess for a trend in dose-response. Further, adequate information on confounding variables would be required. Identifying the confounding variables up-front may be somewhat difficult without knowledge of which exposures or outcomes will be a concern and subject to analysis. Will sufficient data ever be available following a deployment to evaluate an exposure/outcome relationship in terms of causation? To avoid an ecological fallacy, quite specific information is required at the individual level. Adequate baseline on conditions and/or symptoms pre-deployment is necessary to establish the critical chronological relationship (exposure must precede the disease to be considered causal). Current pre-deployment questionnaires are fairly simplistic, although the "seamless medical record," which has been proposed, may alleviate this problem.

Causality is supported by the strength of the association, in that the greater the magnitude of the

demonstrated association, the more likely the significance.¹⁹ Low-level exposures, such as those evaluated with respect to hazardous waste and health effects have largely been determined to pose low-level risks with broad confidence intervals.¹⁵ Causality is also supported if a dose-response trend can be demonstrated, that is, that those with the most intense and longest duration exposure have a greater chance of developing the outcome. Given enough data points of exposure magnitude and/or duration, and a sufficiently large population, this would be a possibility. Another criteria that supports causality relates to the specificity of the association. If the effect or outcome is specific and/or unusual, associated with the particular potential cause, the relationship between exposure and outcome is more likely to be causal. Whether or not this factor will be relevant depends to some degree on the potential exposures and mechanisms of toxicity. If an unusual outcome is identified, relating it to a particular exposure would be dependent upon the toxicological research associated with that outcome, or more specifically, potential exposures associated with that outcome.

Another criterion that supports causation is consistency of the association. If many observers in many studies or settings have replicated the finding, then the role of chance as an explanation for the finding is minimized. Abundant data on particulates and respiratory effects exist, and so for example, if a finding related to particulate levels and respiratory disease outcomes is noted, causality would be much less of a question. The remaining criterion for causality is biological plausibility. The connection between the potential cause and the possible effect must make biological sense. Documented exposures and documented outcomes may be associated statistically, but causality requires that some plausible mechanism link the two. For example, basic research is currently funded to elucidate the mechanisms of neurotoxic damage to provide support for hypotheses related to exposures in the Gulf and neurological outcomes, since there is at least a plausible mechanistic link.²⁰⁻²²

"Recent military deployments, especially in Vietnam and the Persian Gulf, have demonstrated that concerns about the health consequences of participation in military action arise long after deployment has ended and that the evaluation of those concerns and provision of health care

to affected personnel may represent formidable challenges to both epidemiologists and to medical caregivers. Although some of these challenges can be attributed to the intrinsic difficulty of evaluating poorly understood clusters of events that were not among the expected consequences of combat or of environmental conditions, they also may be attributed in part to limitations of the systems used to collect and manage data regarding the health and service-related exposures of military personnel. No system of record keeping can be expected to provide the information needed to address every unanticipated research issue, including the health consequences of military service."¹⁰

These were the conclusions of the IOM report regarding research and information systems. Nonetheless, the DOD has taken seriously the recommendations of such panels and groups, and has earnestly accepted the challenge of implementing them, while grappling with the implications of low-level risk. The National Research Council (NRC) Report, released in 2000, notes that "Changes in missions and increasing use of U.S. forces around the globe in operations other than war focuses attention on threats of DNBI that differ from the concerns of avoidances and treatment of combat casualties... At the same time, the military is expected to take increasing responsibility for examining the potential health and safety risks to its troops and the spectrum of concerns is broadening from acute illnesses and injury as a result of disease exposures, mishaps and accidents to possible influences of low-level chemical and physical exposures on chronic diseases that might manifest themselves years later, perhaps long after cessation of military service."¹³ While there is still discussion regarding the scope and appropriate level of threat of concern as a basis for decision-making, and for epidemiological use, current monitoring affords our troops more varied and sensitive sampling of their environment than any working population in the world. Interestingly, the issue of the use of this information was addressed by the NRC as well: "A unique aspect of risk assessment for deployed troops is the degree to which it might be necessary for commanders to weigh the trade-offs between risks to the military mission and risks to the health and well-being of the troops under their command. Questions regarding how such trade-offs should be made and how much peril the troops should be subjected to in the fulfillment of military objectives are key, but they are also beyond the scope of this report."¹³ These

issues remain key and remain unresolved.

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Depleted Uranium: Managing Battlefield Risks

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Introduction

Although it has been in the American arsenal since the 1970s, U.S. Forces used depleted uranium (DU) for the first time in combat during the 1991 Gulf War Operation Desert Storm (ODS).¹ The use of large-caliber DU anti-armor munitions, coupled with Heavy Abrams tanks with DU armor, gave U.S. Army units the combat edge and helped secure their overwhelming victory against Iraqi forces. But the Army was not alone in exploiting the benefits of DU. The U.S. Air Force A-10 and U.S. Marine Corps Harrier aircraft and tanks also fired DU munitions. Unfortunately, approximately 35 U.S. soldiers were in vehicles hit by DU fired by friendly forces during ODS.^{2,3} This, coupled with post-war concerns about the alleged link between Gulf War related illnesses and the use of DU, prompted the U.S. Army Medical Department (AMEDD) to assess the potential for intake of DU by soldiers during ODS. The DU controversy reintensified most recently in the Winter of 2000 with international concerns over the presence of trace quantities of transuranic elements (plutonium, americium, and neptunium) in the DU used by the North Atlantic Treaty Organization (NATO) aircraft during operations in Bosnia and Kosovo in the mid to late 1990s.^{3,4} While DU is but one of many potential hazards on the battlefield, the important lessons learned from the use of DU in ODS make it a sentinel event in the management of battlefield risks.

Why DU was Used

The DU has unique metallurgic properties that make it ideal for military uses. Given its ability to "self-sharpen," DU makes a very effective kinetic energy penetrator that can easily cut through conventional armor. It is for this reason that U.S. tankers wanted their "silver bullet," as the DU munitions were affectionately dubbed. When used in

armor, DU effectively resists penetration by anti-armor munitions, thereby protecting soldiers. Its effectiveness as a munition, along with its protective qualities in armor, support repeated claims that DU saved American lives during ODS.

Health and Environmental Effects of DU

The DU is a slightly radioactive material that also possesses heavy metal properties. It is obtained as a by-product of the processing of uranium for reactor fuel and nuclear weapons. This process, called enrichment, takes natural uranium found in the earth and removes about 70% of the uranium-235 (U-235), the isotope of uranium needed for fuel and weapons. The remaining uranium is now "depleted" in the amount of U-235 and is referred to as depleted uranium or DU. As a result, DU is 40% less radioactive than the natural uranium in the environment that we all breathe, eat, and drink daily.⁵ In addition to the military uses already described, it is used in the civilian sector, for example, as shielding in medical linear accelerators used for cancer treatment and as ballast on aircraft.^{5,6}

The health and environmental effects of DU have been studied for decades and are very well understood.⁶ Because DU emits radiation, it is a potential source of radiation dose. External to the body, bare DU rods, such as spent munitions, can result in radiation doses exceeding peacetime occupational standards if held in contact with the skin for prolonged periods (in excess of 10 days, an unrealistic scenario). Intact rounds and armor do not result in unsafe radiation doses to personnel. When DU rounds strike armored targets or when DU armor is struck by anti-armor munitions, fine particles of DU are formed that can be internalized via inhalation and ingestion. Studies have shown that only personnel in, on, or near (less than 50

meters) may internalize DU in amounts that may exceed peacetime safety standards. Individuals, such as repair personnel, routinely entering armored vehicles contaminated with DU might also have intakes approaching safety standards if they did not exercise simple precautions, such as wearing respiratory protection. Finally, due to the reprocessing of nuclear fuel, DU may contain trace amounts of other radionuclides such as isotopes of plutonium, americium, neptunium, and technetium; however, these impurities contribute less than 1% of the dose delivered by the DU and, therefore, are insignificant from a health perspective.⁷

Because DU is a heavy metal, it exhibits the similar effects of other heavy metals, such as lead and tungsten. Soluble DU is a potential nephrotoxin and, if internalized in large amounts, can affect the kidneys. It is important to note that no kidney function damage has been reported for individuals with the highest level of DU intake, ODS veterans with embedded DU fragments.⁸

The impact of DU on the environment has also been studied for decades. The Army, Navy, and Air Force all have active ranges where DU munitions have been fired for test and evaluation purposes. These facilities are licensed and inspected by civilian regulatory agencies such as the United States Nuclear Regulatory Commission and have active environmental monitoring programs. To date, DU use at these ranges has not resulted in any significant environmental impact. As confirmed by strict civilian regulatory oversight, operations at these ranges continue to be safe.¹

DU and Gulf War Illnesses

As previously discussed, the potential health effects of DU include both radiological (the increase in the risk of cancer induction due to radiation) and chemical (nephrotoxicity for large amounts of intake). However, an independent review by the National Academy of Sciences Institute of Medicine concluded there was inadequate or insufficient data to conclude that exposure to uranium is associated with the variety of health conditions that Gulf War veterans were experiencing.⁹ Based upon this and other independent reviews, Office of the Special Assistant for Gulf War Illnesses (OSAGWI), in their final assessment concluded the following:

“Taken together, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) assessments, medical follow-up findings, and the recent scientific reviews form an increasingly solid body of medical and scientific evidence that DU is not causing Gulf War Veterans’ illnesses.”³

Lessons Learned from ODS

One of the first lessons learned was the need to provide DU awareness training to all soldiers, sailors, marines, and airmen. While adequate training was provided to the individuals storing, handling, and using DU, other personnel were not aware that DU was used in munitions and armor or what the potential adverse health effects of DU might be. This gap in training was identified by the U.S. General Accounting Office, which recommended an expanded training effort to include all soldiers, sailors, marines, and airmen.¹⁰

There was no clear guidance on proper medical treatment of soldiers with embedded fragments of DU or who had potentially inhaled or ingested DU. As a result, clinicians were not sure how to respond to such individuals when they presented themselves. Responses ranged from blanket assurances that there was no risk to the consideration of limb amputation for individuals with embedded fragments. Despite decades of research on uranium health effects, there was a paucity of data on the short- and long-term effects of embedded DU fragments. This was a previously unrecognized data gap on the health effects of DU due to this combat-related route of intake. To the AMEDD’s credit, this gap was recognized and a plan for animal research, plus medical surveillance of soldiers with retained DU fragments that could not safely be removed, was implemented.

The need for a more independent peer review process for health and safety data was another lesson learned from the ODS experience. The Army has always had a rigorous internal program for assessing the health hazards associated with our weapons system. Our DU weapon systems were extensively tested, but the results of these tests were published in Army or contractor technical reports that were not independently peer-reviewed. This lack of independent peer-review undermined the

credibility of these reports and, in some instances, resulted in data gaps that may have been identified by independent peer review.

One such example of a previously unidentified data gap in Army generated reports came to light when the USACHPPM attempted to estimate potential DU intakes for ODS veterans. Although existing data was robust enough to allow valid estimation of potential DU intakes for most Gulf War exposure scenarios (which were determined to be well below peacetime occupational standards), these same data did not properly characterize the concentration of DU in, on, or near an armored vehicle at the time of armor penetration by the DU penetrator. Even though the number of individuals potentially exposed was small, only on the order of a few dozen, this ODS exposure scenario had the greatest potential for DU intake. Hence, this was an important data gap that needed to be filled.

The DU also served as an important case study illustrating the real challenge in properly managing battlefield risks. Few would argue that the battlefield is not inherently dangerous. There are risks unique to combat (enemy action, and there are also occupational and environmental risks such as accidents and pollution). The Army's goal is to harmonize these risks so that the mission is accomplished while the total risk to the soldier is minimized. For example, it would not make sense to tell a soldier to don his protective mask to protect against potential exposure to DU dust if that action resulted in him stepping on a land mine or reducing his ability to effectively engage the enemy with his weapon. By overprotecting a soldier against potential risks, precautions thought prudent in peacetime might inadvertently end up killing the very soldier for whom these measures were meant to protect. Consequently, blind adherence to peacetime standards does not work when applied on the modern battlefield. It is imperative that any recommendations concerning protective actions must properly take into account the tactical situation. Otherwise, one may end up doing more harm than good.

Implementation of Lessons Learned

In response to the lack of awareness training, the AMEDD partnered with the U.S. Army Materiel

Command, the developers of the DU munitions and armor, and the U.S. Army Training and Doctrine Command, the Major Command responsible for training within the Army, and developed a DU awareness training program comprised of a video and supporting general training aids.¹¹ Health risk communicators at USACHPPM ensured that the training properly conveyed the risks and actions to reduce the likelihood of DU intake (such as wearing gloves, donning a protective mask when entering potentially contaminated vehicles, and exercising proper field sanitation by washing hands before eating). Additionally, individual soldiers are required to demonstrate DU awareness as part of the common task test program. It is hoped that this DU awareness training will serve as the "place holder" for more comprehensive training that addresses all of the occupational and environmental hazards on the battlefield, not just DU.

The U.S. Army Medical Command developed a clear policy for the treatment of soldiers with DU embedded fragments that calls for the removal of DU fragments 1 cm or larger unless clinically contraindicated.¹² Training was provided to AMEDD health care providers on DU, its health risks, and the new treatment policy. The AMEDD requested that the Armed Forces Radiobiology Research Institute conduct in vitro and animal studies on the short- and long-term health effects of embedded fragments.¹³⁻¹⁶ This essential research is currently ongoing and providing important information on the risks from this uniquely military route of intake.

In order to better estimate intakes to soldiers in, on, or near armored vehicles penetrated by DU, the Department of Defense OSAGWI, Medical Readiness (MR), and Military Deployments (MD) and the Assistant Secretary of the Army for Acquisition, Logistics, and Technology jointly funded a multimillion-dollar series of tests. These tests, coined as DU Capstone, involve measuring the DU aerosol generated during the actual penetration of Abrams series tanks and Bradley Fighting Vehicles in an attempt to recreate exposure scenarios experienced during ODS. The DU Capstone series of tests, concluding in Summer 2001, is providing critical data that will allow proper estimation of airborne DU concentrations and valid estimations of intake for individuals with the highest potential intakes of DU: crewmembers, first responders, and battle damage assessment and repair personnel.

To better ensure the credibility of Army assessments of potential DU intake during ODS, the most recent USACHPPM Health Risk Characterization (2000) was subject to rigorous external peer review by competent scientific experts outside of the Defense Department.^{7,17} Additionally, the DU Capstone Tests have also been peer reviewed; this review included the objectives of the tests, the actual test plans, and will include the final DU Capstone report. When USACHPPM revises its Health Risk Characterization based upon the new DU Capstone data, this assessment will also be externally reviewed. This process should convince reasonable skeptics of the validity of the data and risks assessed based upon that data. Once completed, these reports will also be made available to individuals and organizations outside of the DOD who wish to obtain them. This will include allies of the U.S., the World Health Organization, and the United Nations.

Preliminary efforts are underway to better harmonize battlefield risks. A vital first step in that direction is the development of a risk classification system for health risks that parallels the risk management approach used to manage safety risks as outlined in FM 100-14, Risk Management.¹⁸ Additionally, USACHPPM is revising its Technical Guide providing guidance on conducting chemical and radiation risk assessments with a new focus on risk harmonization.¹⁹ At the policy level, a Department of the Army Environmental, Safety, and Occupational Health Working Group has been chartered to forge Army policy in the arena of risk harmonization. Although there is still a long way to go, this is a crucial beginning in the process that will ultimately allow tactical commanders to effectively manage competing risks and reduce the overall risk to the combat soldier.

Summary

The first wartime use of DU sparked considerable controversy and revealed gaps in the adequacy of Army DU awareness training, proper medical management of individuals with embedded DU fragments, and the scientific understanding of health effects from such fragments. It also underscored the need to accurately assess potential DU intakes during combat for soldiers in, on, or near armored vehicles at the time DU penetrates the armor. The good news is that, under OSAGWI/MR/MD leadership, the U.S. Army and AMEDD marshaled critical

resources in a concerted effort directed towards addressing these shortfalls. Responding to concerns about DU also illustrated the need for external peer review of Army safety and health assessments in order to restore trust, along with an urgent need for an overarching Army policy to harmonize risks on the battlefield. Hence, the lessons learned from the use of DU in ODS will assist the AMEDD in responding to other potential hazards in future conflicts. In this way, the mistakes of the past hopefully will not be repeated.

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Occupational and Environmental Health Surveillance

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Purpose

Operation Desert Shield/Storm caused the Department of Defense (DOD) to take a hard look at Force Health Protection (FHP) issues in general and Occupational and Environmental Health (OEH) surveillance issues in particular. The following provides a summary of the U.S. Army Center for Health Promotion and Preventive Medicine's (USACHPPM) efforts to design and deploy a Deployment OEH Surveillance Program as part of a comprehensive military medical surveillance capability for the DOD to support FHP goals.

Background

FHP Concept. Whether engaged in armed conflict or deployed in support of peacekeeping operations, military commanders are concerned about any activity which, potentially, could threaten their personnel. In particular, commanders are becoming increasingly concerned about the health threats their personnel face and the ways to prevent these threats. The Joint Chiefs of Staff have developed a FHP strategy designed to protect and sustain the total force, to include service members' families throughout the entire duration of their service commitment. The FHP strategy has three basic tenets: a healthy and fit force, casualty prevention, and casualty care. These occur within a continuous cycle of Personnel Monitoring, Environmental Monitoring, Personal Protection, and Health Care. A medical surveillance program supports FHP by collecting, integrating, analyzing, and disseminating information on the overall effectiveness of FHP measures by:

- Identifying troop populations at risk for diseases and injuries.

- Identifying significant environmental and occupational hazards and documenting exposures.

- Determining the impact of disease or nonbattle injury (DNBI) on readiness.

- Providing decision support for commanders, policy makers, and others who can act to prevent diseases and injury.

- Monitoring the effectiveness of prevention strategies and programs.

- Prioritizing research for effective prevention efforts.

USACHPPM Role in Medical Surveillance. As the DOD Executive Agent for Medical Surveillance databases and data analysis for deployments, the USACHPPM has taken a lead role in the design and execution of the DOD medical surveillance capability. Current efforts, to date, have concentrated on two aspects of medical surveillance: a comprehensive health outcome database, known as the Defense Medical Surveillance System, and a comprehensive occupational and environmental hazard surveillance effort under the Deployment Environmental Surveillance Program (DESP). This article summarizes the efforts of the DESP.

DESP Organization

General. The USACHPPM DESP was established in July 1996 to serve as a single point of contact for deployment OEH surveillance issues as part of the Center's Executive Agency for medical surveillance databases and deployment surveillance analysis. This was largely in response to the DOD's increasing concerns, especially since the Gulf War, to the risks posed to U.S.

Forces by environmental hazards. The mission of the DESP is to develop a system capable of providing commanders and other decision makers pertinent information needed to detect, assess, and counter environmental and occupational hazards. The DESP is staffed by environmental scientists, engineers, health risk assessors, and geographers, and provided matrixed support from occupational medicine physicians, industrial hygienists, entomologists, health physicists, ergonomists, chemists, and epidemiologists assigned to the technical programs throughout the USACHPPM. Extensive deployment OEH surveillance support is provided by the personnel assigned to the USACHPPM subordinate commands, particularly the USACHPPM-Europe command located in Landstuhl, Germany.

Program Functions. The current primary functions of the USACHPPM DESP are the analysis of data and dissemination of information concerning the detection, assessment, and reduction of occupational and environmental hazards and health risks during deployments. The program accomplishes this effort via the following services:

- Consultative assistance, laboratory analyses, and on-site environmental surveillance to deployed preventive medicine assets to identify, prevent, and reduce potential environmental health risks.
- Spatial and temporal analysis of potential environmental and occupational exposures and health risks using geographic information systems and integrating this information with health outcome data to identify necessary changes in medical threat assessment and countermeasures.
- Archiving environmental and occupational hazard data collected by deployed units in-theater to allow investigations of any future adverse health outcomes following a deployment.
- Development of standardized guidance documents and decision criteria for environmental and occupational hazard identification, exposure monitoring, and risk assessment suitable for military operations.
- Personnel training on the use of technical guidance and environmental monitoring equipment.

- Support development of policies and doctrine for surveillance and control of environmental and occupational hazards during deployments.

Focus Areas

The primary focus areas for the USACHPPM OEH surveillance efforts are continued support to Gulf War Illnesses (GWI) investigations; continued OEH surveillance efforts for ongoing military operations (Operation Joint Guard [OJG]/Forge [OJF] in Bosnia, Operation Allied Force/Joint Guardian in Kosovo, Operation Southern Watch in Southwest Asia; various Army and Air Force initiatives throughout Africa); developing improved methods of collecting OEH hazard data in deployment areas; development of standard data collection, analyses, and risk assessment procedures in technical guides to be used by field personnel; supporting DOD efforts to identify doctrine, materiel, and data gaps associated with low-level chemical warfare agent exposures; development of health-based chemical concentration criteria for toxic chemicals to be used in decision-making for deployments as well as domestic incidents; and developing joint policy in concert with the Joint Environmental Surveillance Working Group (JESWG).

Significant Accomplishments

GWI Investigative Support. Starting with the 1991 assessment of the OEH risks from the Kuwaiti Oil Well Fires, the USACHPPM has continued to provide major support to the DOD's GWI investigative efforts (Figures 1 and 2).^{1,2} Since 1996, the main efforts of the GWI support were to assist the Office of the Assistant Secretary of Defense's Special Assistant for Gulf War Illnesses (OSAGWI) in various studies of potential environmental exposures to U.S. Forces during the Gulf War. These efforts were concerned with conducting analyses of potential chemical agent exposures to modeled releases from the Khamisiyah Depot demolition operations and other potential chemical agent releases; the health risks associated with exposures to depleted uranium munitions, the risks from oil well fire smoke exposure, and various other potential exposures such as chemical agent resistive coating paint, pesticides, and pyrostigmine bromide.³⁻⁸ They also included assisting with enhancements to the

Troop Movement Database compiled by the U.S. Joint Services Center for the Research of Unit Records. Two program efforts that directly interfaced with and affected individual veterans are a joint study with the Veterans Administration (VA) of the incidence of Amyotrophic Lateral Sclerosis (better known as ALS or Lou Gehrig's disease) among Gulf War veterans and a program to conduct individual assessments of oil fire smoke exposure as mandated by Public Laws 102-190 and 102-585.



Fig 1. Fire fighting efforts in Kuwait, May 1991.

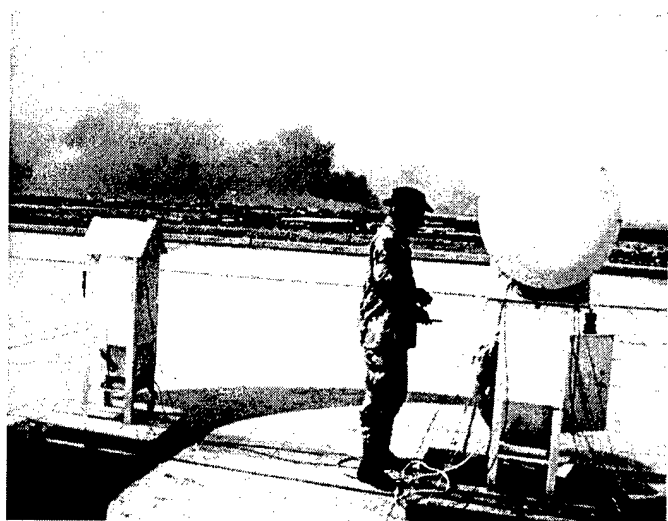


Fig 2. Air sampling conducted by USACHPPM personnel at Camp Doha, Kuwait, May 1991.

The program is also providing exposure data and analysis to several prominent multiagency studies including the National Health Survey of Gulf War Era Veterans and their Families and the Combined Analysis of

VA and DOD Gulf War Clinical Registries. Program personnel are also heavily involved trying to improve the health of deployed U.S. Forces, working with the National Research Council project on Strategies to Protect the Health of Deployed U.S. Forces. The GWI team members have also testified on several occasions before the Presidential Special Oversight Board investigating environmental exposures to U.S. Forces in the Persian Gulf. A major effort underway within the program is the development of an interactive web site where Gulf War veterans can log on and determine their individual oil fire exposure levels and potential health risk. This site should be functioning within this calendar year.

Current Operations Support.

- *Operation Joint Forge – Bosnia.* The environmental surveillance for Operation Joint Endeavor (OJE), OJG, and OJF has been the most comprehensive of any U.S. Forces deployment.^{9,10} It involves a coordinated approach between deployed table of organization and equipment units and table of distribution and allowances organizations. The effort, started by the 30th Medical Brigade in January 1996, is serving as the template for future development of a Joint Medical Surveillance System as envisioned by the DOD directive. To date, environmental samples have been collected from all U.S. base camps in Bosnia and from several other International Forces camps in Bosnia, Croatia, and Hungary. This surveillance has been done by deployed military preventive medicine detachments, the U.S. Army 520th Theater Army Medical Laboratory (TAML), and personnel from the USACHPPM Headquarters (HQ), USACHPPM-Europe, and USACHPPM CONUS subordinate commands. The primary environmental media sampled included air, water, and soil. Sampling parameters included inorganics such as sulfur dioxide and dissolved solids, volatile and semivolatile organic compounds, metals, pesticides, herbicides, and particulate matter. All results are compared to developing soldier exposure criteria, U.S. Environmental Protection Agency (EPA) standards, and other applicable exposure standards and calculated exposure risks. Various contaminants were detected in the ambient air of the base camps (Figures 3 4). Most were at concentrations below those regulated by U.S. National Ambient Air Quality Standards (NAAQS) or EPA Region III Risk Based Concentrations (RBCs).

Those contaminants that exceeded the NAAQS or RBCs were typical of those found in U.S. urban areas. These levels are not expected to pose a significant risk to U.S. Forces due to the short exposure duration and healthy young adult population.



Fig 3. Camp Ugljevik, Bosnia, with adjacent coal-fired power plant.

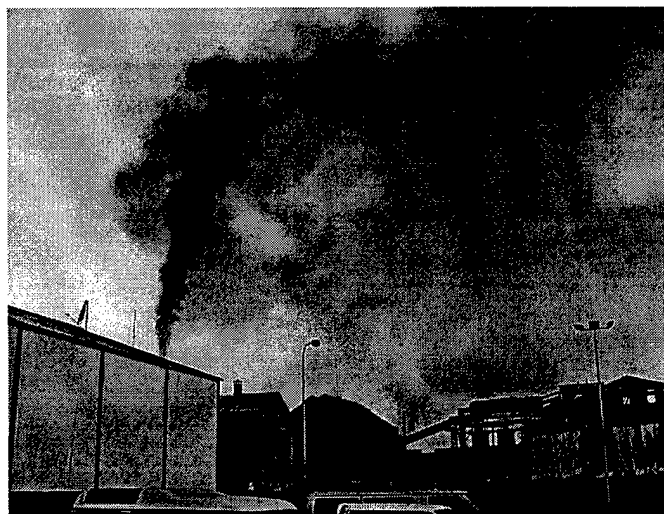


Fig 4. Visible industrial air pollution observed by U.S. Forces in Bosnia.

- *Operation Southern Watch.* Since 1998, the DESP has conducted OEH surveillance activities for the U.S. Central Command (USCENTCOM) and respective component commands. These activities are in response to the Joint Staff Medical Readiness Division directed environmental health surveillance program for the USCENTCOM, which supports the Surgeons Offices and the Engineers, Operations, and Intelligence Directorates. In April 2000, a comprehensive environmental health surveillance assessment began at Camp Doha, Kuwait.

Levels of ambient pollutants to include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, particulate matter less than 10 microns, and lead are continuously monitored by direct reading instrumentation contained in a climate controlled trailer. The DESP trained the Camp Doha Directorate of Public Works and Troop Medical Clinic personnel on trailer operation and maintenance. The collected environmental health surveillance data are compiled and assessed against both deployed military exposure guidelines by the USACHPPM and DNBI rates maintained by the U.S. Air Force Institute for Environment, Safety, Occupational Health Risk Analysis. The DESP, along with the USACHPPM-Europe, continues to support an environmental health surveillance program for Eskan Village, Saudi Arabia. Both CONUS-based analyses and data assimilation/reporting measures are provided to the U.S. Air Force 320th Air Expeditionary Group and the 3d U.S. Army/Army Forces Central Command-Saudi Arabia. In addition, the DESP assisted the 3d U.S. Army/Army Forces Central Command with analytical and data assimilation/reporting measures for a pre-deployment site survey for Bright Star 2001; a road engineering project in Jordan (Eastern Castle Exercise); and Shuaiba Industrial Area, Kuwait (Native Atlas Exercise) assessments (Figure 5).

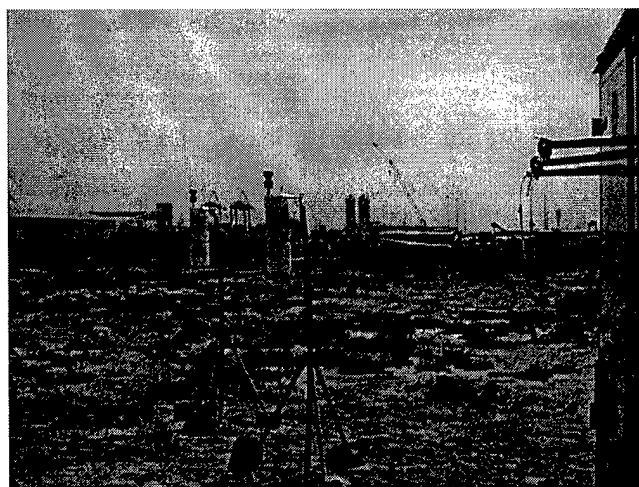


Fig 5. Air sampling location at Shuaiba Port, Kuwait, in support of Native Atlas Exercise.

- *Operation Joint Guardian – Kosovo.* With the end of the NATO air campaign against Yugoslavia in June 1999, U.S. Forces established two major base camps in Kosovo for the start of Operation Joint Guardian. The OEH surveillance was implemented by the preventive

medicine units assigned to Task Force Medical Falcon to protect troops from environmental contamination in water, soil, and air throughout the area of operations. The OEH surveillance training was provided to these units. The USACHPPM, led by personnel from USACHPPM-Europe and the Task Force Medical Falcon preventive medicine units, conducted industrial hygiene, entomological, environmental, and radiation assessments at each of the base camps within Kosovo in 2000 (Figures 6 and 7).¹¹⁻¹⁶ In addition, USACHPPM was tasked to conduct environmental surveillance for KFOR at the main and rear HQ, French HQ in Mitrovica, and Blace Border crossing (Figure 8). A team from USACHPPM-Europe also conducted a site survey, in March 2000, at target sites where depleted uranium was fired during Operation Allied Force. At the same time, routine environmental water and soil samples taken by the preventive medicine units have

been analyzed by the USACHPPM-Europe to determine any potential health threats. These sampling data are being archived at the DESP. The USACHPPM is planning additional assessments in Kosovo in 2001. This will include the collection of soil samples and conducting environmental reconnaissance at the 26 small outposts in the U.S. Sector. This effort has expanded to include participation with the United Nation's Environmental Program and World Health Organization's assessment of depleted uranium usage in the Balkans.

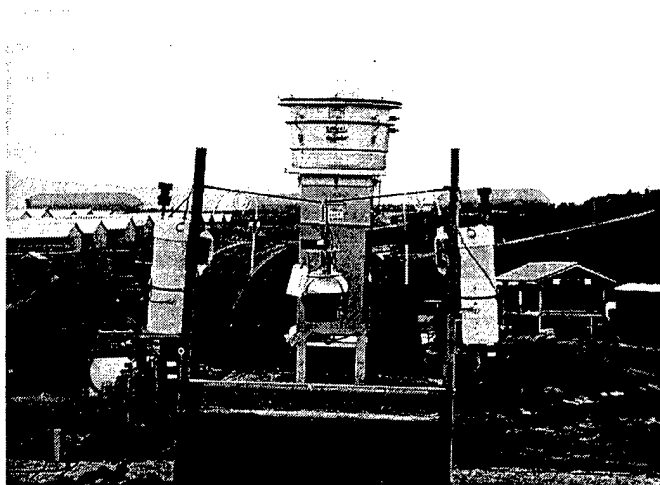


Fig 6. Environmental air sampling at Camp Bondsteel, Kosovo.

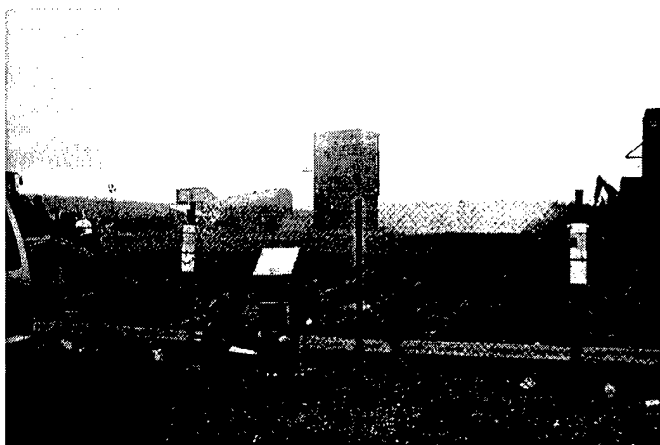


Fig 7. Air sampling near an incinerator at Camp Bondsteel, Kosovo.

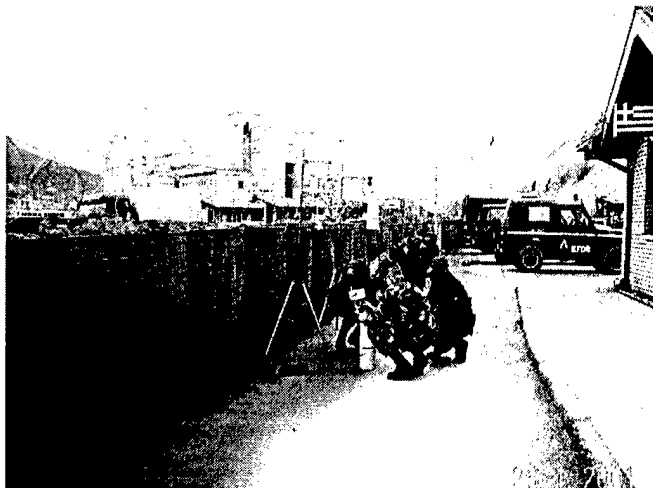


Fig 8. USACHPPM personnel setting up air samplers near the cement plant at the Blace Border Crossing in Kosovo.

Medical Nuclear, Chemical, Biological (NBC) Efforts. As part of the overall OTSG sponsored Medical NBC program, the USACHPPM initiated a multi-disciplinary effort to develop various deployment OEH surveillance protocols, risk assessment guidance, and training efforts to assist with identifying and assessing various deployment OEH hazards such as toxic industrial compounds and radiological health hazards. This effort has consisted of developing enhanced sampling methods for military deployments for both environmental and radiological hazards, risk assessment guidance for short- and long-term chemical exposures, enhanced hazard identification guidance for medical, industrial, research, and military radiological hazards, and an effort to develop an integrated approach to assess deployment OEH risks in terms of the overall Operational Risk Management concept used by the deployed force. A list of the technical guidance documents developed under this program is included on the following page.

- TG 230A – Short-Term Chemical Exposure Guidelines (1 hour-2 weeks) – Final

- TG 230B – Long-Term Chemical Exposure Guidelines (1 year) – Draft

- TG-244 – The Medical NBC Battlebook – Final

- TG-238 – Radiological Sources of Potential Exposure and/or Contamination – Final

- TG-236A – Basic Radiological Dose Estimation – A Field Guide – Final

- RD-236A – The Technical Foundation for Basic Radiological Dose Estimation – Draft

- TG-236B – Advanced Radiological Dose Estimation – Draft

- TG 251 – Deployment Environmental Surveillance Sampling Guide – Draft

- TG 248 – Guide for Deployed Military Personnel on Health Hazard Risk Management – Draft

Environmental Surveillance Method Development (ESMD). The currently available environmental exposure surveillance methodology requires that complex, expensive environmental sampling equipment and health risk assessment analytical techniques designed for use in garrison scenarios such as the installation restoration program, be deployed to adequately assess potential environmental exposures such as low-level releases of chemical warfare materials and other toxic industrial chemicals. Existing joint service preventive medicine force structure, training, equipment, logistical support, and doctrine are inadequate to employ these approaches on the regular basis needed to support contingency operation force protection requirements. The ESMD project was initiated to develop environmental sampling methods for military deployments. It is intended to modify environmental exposure surveillance equipment and methods suitable for contingency operations using commercial off-the-shelf technologies. In particular, the 1999 effort was focused on potable water and soil sampling methodologies for deployment situations. The potable water sampling kit (Figure 9), which historically required approximately 16

liters of sample, has been reduced to 0.8 liters. Soil sample volume was also reduced and collection practices consolidated. The potable water and soil sampling kit initiated the development of an environmental sampling backpack that would allow portable and complete sampling capabilities to various preventive medicine personnel. Modified ambient air sampling equipment with reduced size and electrical power needs is also being used and evaluated in current contingency operations. Sampling methodologies will be integrated into TG-251 "Environmental Sampling Guide."



Fig 9. The deployment water sampling kit, replacing the larger kit used for CONUS sampling is shown in the foreground.

Deployment OEH Surveillance Training. Training deployed preventive medicine assets on the emerging concepts of deployment OEH Surveillance occupied a major portion of the USACHPPM's efforts in OEH. Along with other Directorate of Environmental Health Engineering programs, the Deputy Chief of Staff for Operations, Field Preventive Medicine Division, held training events to promote, support, sustain, and enhance the ability of TOE units to identify and assess deployment OEH risks. The training events and sustaining documents were in support of the goals of the JESWG, the Medical NBC system development, and military exercises and deployments (Operations Joint Guardian and Southern Watch, KFOR, events supported by the U.S. Army 520th TAML, and other DOD branches).

Training events were designed to meet the specific audience's needs, but primarily had a multi-media focus.

They include: (1) an understanding of a water, and soil) approach to environmental surveillance; (2) an introduction to environmental pollutants and their exposure pathways; (3) an overview of environmental sampling strategies, equipment, and methodologies; and (4) identifying hazards and associating risks in a deployment setting. As a general example, a training event could focus on determining the industrial hazards that personnel (military and civilian) in a foreign country would be exposed to on a 2-week and/or a 60-plus day exercise. Training would consist of how to use air sampling equipment, taking a sample using a deployment water kit, determining sampling scenario(s) as well as identifying the possible risks and/or hazards associated with industrial operations. The audiences for the training events included personnel from throughout the USACHPPM, Preventive Medicine Units, Special Medical Augmentation Response Team-Preventive Medicine or Disaster Relief Response Teams, Uniformed Services University of the Health Sciences and Army Medical Department Center and School (AMEDDC&S) students, and other DOD personnel (active duty and reserve).

OEH Policy Development.

- *Joint Environmental Surveillance Workgroup.* In Oct 97, the Joint Preventive Medicine Policy Group, chartered by the Assistant Secretary of Defense for Health Affairs, directed the formation of a JESWG. Chaired by the USACHPPM, the JESWG was directed to review, develop, and recommend functional aspects of environmental surveillance policy for consideration by the Joint Preventive Medicine Policy Group. The JESWG membership is comprised of representatives of the USACHPPM; the U.S. Navy Environmental Health Center; the U.S. Air Force Institute for Environmental, Safety, and Occupational Health Risk Analysis; Armed Forces Medical Intelligence Center; and the Medical Readiness Division of the J-4 as a core or executive membership. Organizations represented in the extended membership of the JESWG include the USAF and USA Secretariats for Environment, Safety and Occupational Health, U.S. Atlantic Command, Uniformed Services University of the Health Sciences, Armed Forces Epidemiology Board, AMEDDC&S, U.S. Army Surgeon General, U.S. Army Forces Command, the USAF Research Laboratory, U.S. Army Center for Environmental Health Research, and

Military and Veteran's Health Coordinating Board. The JESWG has met quarterly throughout its tenure. During this period, the group developed extensive input into the Draft Joint Instruction for Deployment Health Surveillance and the Joint Chief's of Staff Memorandum on Deployment Health Surveillance. They also participated in meetings of the National Research Council's evaluation of Strategies to Protect the Health of Deployed U.S. Forces, prioritized Information Management/Information Technology requirements for Deployment OEHSurveillance for the Theater Medical Information Program and Defense OEHSurveillance System. Other initiatives included development of a white paper that describes a fully mature deployment OEHSurveillance program, and initiation of a strategic action plan for deployment OEHSurveillance.

- *Low-Level Exposures to Chemical Warfare Agents.* The USACHPPM has increased its involvement with the military research and operational communities in efforts toward identifying new policy and doctrinal goals required to address Congressional and Presidential directives toward an improved chemical defense program. Simultaneously, this effort involves focusing research initiatives to address key data gaps necessary to support doctrinal changes.

Conclusion

Significant steps have been taken by the DOD since Operation Desert Storm to protect the health of service members from occupational and environmental exposures that occur during deployments. The OEHSurveillance conducted during deployments has become an integral part of the current FHP paradigm used by the DOD to protect our deployed service members. Although much progress has been made, significant work remains to be accomplished before this area of FHP is fully mature and integrated into the DOD.

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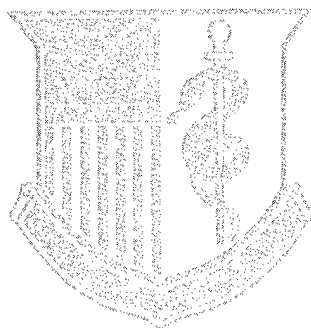
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Pharmaceutical Care Lessons Learned

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Introduction

Pharmacy-related services in the U.S. Army can be traced back to the establishment of “A Hospital for an Army,” by the Continental Congress, in 1775, and the appointment of an “apothecary.” The law of 27 July 1775 that established the “Hospital” (read Medical Department in the Continental Army) also established “one apothecary” at the pay of \$1.33 per day.¹ The apothecary was “to visit and attend the sick” along with the surgeons and mates – choice of the apothecary was left to Dr Benjamin Church, the first director general/chief physician. In the law of April 1777, the Continental Congress authorized “apothecary generals” for each hospital department (there were then three – northern, middle, and southern departments) under a director general, all of which came under the director general/chief physician of the Hospital Department. Andrew Craigie was the first Apothecary General appointed in 1777. In September 1780, an apothecary was placed under the director general/chief physician to handle “medicines and refreshments.” Since that time, the duties and extent of responsibilities for rendering pharmaceutical services and care to the soldier, both in garrison and in the field, has evolved. Army Pharmacy (Active, Reserve, Officer, Enlisted, and Civilian supporting staff) must operate an extensive supporting infrastructure in order to ensure a safe and efficacious product is delivered to the soldier. Operation Desert Shield/Storm (ODS), as with previous operations, offered unique challenges in the delivery of pharmaceutical care to the fighting soldier. This article will focus on two areas that directly impacted on Army pharmacy during ODS: the lessons learned from pharmacy’s involvement, and the impact on the delivery of pharmaceutical care rendered to

soldiers today. The specific areas examined are in pharmaceutical supply and investigational drug use.

Pharmaceutical Supply

Pharmaceutical supply services encompass the procurement, appropriate storage, and distribution of medications in the theater of operations. To ensure the availability of medications to support the Army Medical Department mission, pharmacy personnel collaborate with the medical staff, logistics, and other support staff.

Initially during ODS, early deployed units (47th Field Hospital and others) had minimal medications available except for medications brought with them from CONUS until 32/47th Medical Supply and Optical Manufacturing (MEDSOM) stood up in Dhahran, Saudi Arabia. Pharmacists played a key role in medical and pharmaceutical supply during the entire operation. Pharmacists were assigned to the MEDSOM, and at least one senior Army Pharmacist became Medical Supply Chief of 47th Field Hospital. One of the major hardships experienced by the 32d MEDSOM was finding a warehouse location with a controlled environment for the appropriate storage of medications and other temperature sensitive medical supplies. The MEDSOM locations changed frequently during the initial days of the deployment, which was extremely disruptive to the establishment of efficient operational and resupply processes. Ensuring the appropriate storage of pharmaceuticals (to include adequacy of temperature control) did not change as a result of this major deployment. One important lesson learned during ODS was that this need could have been met with a temperature-controlled

warehouse for medical logistic units. Additionally, an important consideration in planning for future deployments should include the provision for refrigerated/heated Sea Land storage vans for controlled temperature storage for medical units. Supporting our fighting forces with beans and bullets were priority for shipment over medications/medical supplies during the early months of the ODS deployment. The importance of appropriate and coordinated medical logistics support to the fighting forces cannot be overemphasized given the fact that, historically, disease and nonbattle injuries have claimed more lives than battle related injuries in all major conflicts. Intravenous fluids are of particular concern – they are critical in acute and routine health care treatment scenarios, and they are bulky for shipment.

It was identified in ODS that contract carriers should be used if necessary for shipment of medications. Medical units were often deployed with limited pharmaceuticals and other medical supplies with limited centralized coordination and standardization as to what supplies were ordered for their particular units. This lack of coordination and standardization created a situation where the MEDSOM was initially over-run with supply requests for medical supplies from all units coming into theater. Medical units, that deployed early during ODS were appropriately concerned when they did not receive their pharmaceuticals supplies immediately from the MEDSOM, which generated additional medical supply requisitions. This phenomenon escalated and led to a worsening of the backlog in the supply pipeline. The goal for the future major deployments should be a more closely coordinated “focused medical logistics” process to avoid the initial inappropriate medical supply requisitions and perceived panic by units that arrive in the area of operation without supplies. The following actions are worthy of consideration:

Units should develop a listing of pharmaceuticals and other medical supplies, which they believe are appropriate to best meet their unit’s medical mission requirements prior to deployment based on Tri-Service policy guidance from the Joint Readiness Clinical Advisory Board (JRCAB). Other factors which should be considered during medical unit pre-deployment planning should include the need for specific medical supply sets, kits, or outfits required for the circumstances of the deployment

with emphasis on selecting items available at the medical treatment facility (MTF).

There should be coordination with the deploying unit’s supporting MTF for ordering of the pharmaceuticals desired through the pharmaceutical prime vendor. The MTF warehouses could then be used to house the consolidated supplies until movement to processing for overseas deployment.

The MTF can serve as an active resource and initial coordination staging point for deploying medical unit’s initial pharmaceutical supply support. The initial MEDSOM order can then be based on those medications that were ordered from the supported units. Requests for additional medications not routinely available, but considered standard of care during deployments and required in theater, could be routed to the theater Surgeon’s office in coordination with the JRCAB and other appropriate Medical Consultants Defense Logistics Agency for subsequent push into the theater in quantities necessary to adequately support all deployed units. Pharmacists who are deployed with units in collaboration with other appropriate medical personnel in theater must be responsible for the coordination of substitute therapies, different brand, or package size. It is imperative that medical units and organizations assume responsibility through their assigned pharmacist for ensuring the appropriate coordination for the procurement, storage, and distribution of pharmaceutical supplies to support deployments.

Investigational New Drug (IND) Use and Pharmacy Involvement

The ODS represented the first military conflict in which the Department of Defense (DOD) deployed investigational products to the theater of operations under protocols submitted to Food and Drug Administration (FDA) approved INDs. Two INDs were deployed for therapeutic purposes and two were deployed for force health protection.

The INDs deployed to military field hospitals for therapeutic purposes were Centoxin® and intravenous ribavirin. Centoxin® (HA-1A) a human monoclonal IgM antibody, was pre-positioned in hospitals for the treatment

of patients with Gram-negative bacteremia secondary to traumatic injury, wounds, or burns. Intravenous ribavirin was available for the treatment of hemorrhagic fevers with renal syndrome. Though available for use, there were no reports that either of these products were used during the period of Desert Shield /Storm.

The force health protection INDs were pentavalent botulinum toxoid vaccine and pyridostigmine bromide (PB) 30 mg tablets. Individuals in units at suspected high risk for exposure to biological weapons including botulism and anthrax were provided the opportunity for immunization against these threats. Anthrax vaccine was available as an FDA approved vaccine. The PB, while approved for the use in myasthenia gravis, was available under an IND as a pre-treatment to enhance the effectiveness of approved antidotes against exposure to soman and tabun, irreversible acetylcholinesterase binding agents.

It is estimated that about 8,000 individuals were immunized with botulinum toxoid vaccine and an estimated 250,000 service members took PB.²⁻⁴ A retrospective survey of medical officers of the XVIII Airborne Corps found that PB was well tolerated with few side effects. Adverse events reported were consistent with the documented muscarinic and nicotinic actions of PB (gastrointestinal problems, excess salivation, fatigue, and headaches).^{3,4} Information on the side effects from botulinum toxoid vaccine has not been published.

The force health protection INDs were administered under a waiver of informed consent procedure developed on the eve of the Gulf War.⁵ However, a decision was made by U.S. Central Command to use an informed consent form for the enrollment of participants in the pentavalent botulinum toxoid protocol. The consistency with which informed consent was obtained has come into question, as those forms were not retrieved after the war.⁶

Pharmacists were involved at several levels in the management of INDs. At the strategic level, pharmacists at the U.S. Army Medical Research and Development Command, predecessor to today's U.S. Army Medical Research and Materiel Command (USAMRMC), were engaged in multiple roles contributing to the deployment of INDs in support of military operations. The pharmacist

assigned as the Human Use Review and Regulatory Affairs Officer was integral in the efforts to establish the FDA regulation allowing the Commissioner to waive informed consent for those situations where obtaining consent was not feasible.^{6,7} Pharmacists were members of The Surgeon General's Human Subjects Research Review Board, the Institutional Review Board that determined that waiver of informed consent was appropriate for the two INDs used for force health protection. The pharmacist at the U.S. Army Medical Materiel Activity managed the distribution of INDs to the theater of operations with the pharmacist at the U.S. Army Medical Materiel Center, Europe, providing additional support in control of INDs. Within the theater of operations, pharmacists at the MEDSOMs assisted in managing the distribution of INDs to military hospitals. Pharmacists at the hospital level were critical to the dissemination of information regarding protocol procedures and drug information regarding the INDs, especially the two therapeutic agents, Centoxin® and ribavirin.

In the intervening years since Desert Storm, pharmacists assigned to the USAMRMC have been active in ensuring that INDs will be available for future military operations. As the primary issues associated with Gulf War Illnesses involved the failure of DOD to adequately inform service members of the use of the INDs and to identify service members participating in IND protocols, the FDA considered the elimination of the regulation providing for a waiver of informed consent.⁶ However, the 1999 National Defense Authorization Act included a provision to preserve the waiver of informed consent by raising the approval authority to the Commander-in-Chief.⁸ An executive order and updated FDA regulations resulted in the identification of specific requirements that must be met in order for the President to consider approving the use of an IND under a waiver of informed consent.⁹ These requirements ensure that while service members may not have an option regarding their participation and receipt of an IND, they will be duly informed and their participation will be recorded to allow appropriate follow-up of health effects.

Pharmacists at USAMRMC are currently coordinating efforts to ensure these new requirements will be fulfilled in any future military operation in which INDs are needed for force health protection. Key to the success of

any future use of investigational products in military contingency operations will be pharmacists who are in a unique position to help educate health care providers, service members, and military leaders in the proper use as well as the risks and benefits associated with the respective investigational products.

Conclusion

Army pharmacy's significant participation in ODS provided some unique challenges that were identified and addressed for future operations. Pharmacy's long history of supporting the soldier and the Army family will continue as long as there is a soldier walking point.

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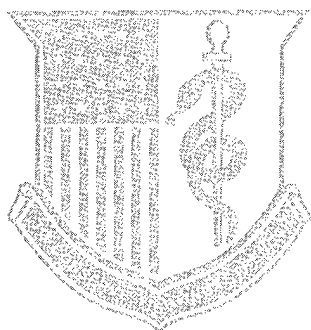
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The Big Red One – A Physician's Experience in the Gulf War

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Introduction

It is with a great sense of accomplishment that I reflect back on the Persian Gulf War 10 years later. The time was an unforgettable experience that had a significant impact on me personally and my military career. It seems like yesterday that I was a young Medical Corps (MC) captain just out of Internal Medicine residency and finally ready to practice as a real doctor. How quickly everything changed; within a matter of months I was in Saudi Arabia preparing to fight the Iraqi Army. The reflections that follow are some of my observations during the war about how well things did or didn't work in a forward medical company of the 1st Infantry Division. Much of the information is from a journal I kept during my deployment, but many of the experiences seem almost new.

Fort Riley, KS — Home of the "Big Red One"

I arrived at Fort Riley, KS, and Irwin Army Community Hospital (IACH) in the middle of July 1990. My 3 years of residency in Internal Medicine at Brooke Army Medical Center (BAMC) was recently completed and I was looking forward to being a staff physician with fewer hours and much easier call nights. Other than residency at a military medical center that has little resemblance to the rest of the Army, I knew little about military life except wearing the uniform and meeting the grooming standards. What military information learned during the Officer Basic Course 6 years earlier had long been forgotten. The first order of business during in-processing was formal notification by the command of my assignment on the Professional Officer Filler System (PROFIS) list to the 1st Infantry Division, nicknamed the "Big Red One." In those days, PROFIS meant very little since the operational tempo of the Army was slow and deployments for physicians were unusual. Life settled down in the routine of the Internal Medicine Clinic with

the other three internists at IACH, but very briefly. In early August 1990, Iraq invaded Kuwait and the U.S. military build-up in the Persian Gulf began soon thereafter. This would directly impact our clinic as one of our internists was sent to backfill the hospital at Fort Sill.

Preparations for Deployment

All of us watched the events unfold over the next several months as the Army initially sent units from the 18th Airborne Corps to deter further aggression by the Iraqi Army. With the deployment of the 1st Cavalry Division from Fort Hood later in the year, it became more personal as some close friends from BAMC were deployed. The rumors began around the hospital that the 1st Infantry Division was next on the list for deployment. I tried to ignore that reality as long as possible but official notification came on 8 November that the division was on alert for deployment. I felt truly devastated, as I didn't know what to expect or what the future held. My brothers, both of whom were previously Marine officers (one had recently left the Marines on 1 August 1990), were supposed to be involved in conflicts, not me. The next month was a whirlwind of activity as I left the hospital prior to Thanksgiving and joined C Company, 201st Forward Support Battalion (FSB) as part of the forward medical company in support of 2d Brigade.

Before the arrival of physicians from Fort Riley to the various medical units within the division, most medical equipment had already been packed and sent to the railhead for shipping overseas. Our main concern was preparing ourselves in terms of weapons, nuclear, biological, chemical, and personal equipment. We did get an abbreviated Chemical Casualty Course at the hospital that proved to be invaluable. Otherwise, we tried to get our medical personnel prepared for their wartime mission. The lack of skill and training for most of the 91B combat

medics was simply appalling and gave new meaning the term "medicanics." Training on simple skills such as patient assessment and intravenous catheter placement were emphasized. Many of the physicians from IACH were given leadership positions since we were the first doctors assigned to the units. My clinic chief from IACH was initially designated the company commander and I was assigned the position of medical treatment platoon leader. Little did I know what that entailed but was willing to do the job with help of the Medical Service Corps officer, 2LT Lenora Kater, normally assigned to that position during peacetime. The first elements of the division deployed in mid-December and each unit subsequently left during the next month. The 201st FSB did not leave until 6 January 1991. After a very subdued holiday season, the unit underwent the daylong process of a final inventory of personal equipment prior to being locked down to leave. Due to delays with the commercial flight, we spent more than a day in a hangar at Fort Riley prior to finally being en route to Saudi Arabia.

Saudi Arabia and the MGM Grand

The weather in Kansas was extremely cold and snowy when we left for Saudi Arabia; there was a distinct change on arrival to the deserts of the Persian Gulf. After roasting on the tarmac, we were eventually bused to our new temporary home at the Khobar Towers, dubbed the "MGM Grand" by its military inhabitants. The massive amount of equipment coming to the ports meant further delay until our equipment arrived. The next 2 weeks were spent waiting and treating numerous minor illnesses, mostly upper respiratory infections. The one thing we didn't carry enough of in our aid bags (the only medical equipment we carried) was cold medications. During this time, there was ample time to read, exercise, write letters, and survive the living conditions. Fifteen thousand troops crammed into apartment buildings with no running water soon became a huge challenge. We were still there when the air war began on the 17th of January. Our introduction to war was getting into Mission-Oriented Protective Posture (MOPP) Level 4 for the next several hours after the bombing began. We truly had little idea what was happening and, like many, relied on Armed Forces radio to keep us updated. Our company finally went to the port area and convoyed out to the desert on the 20th. It was good to

leave the confines of the MGM Grand where we had spent the last several nights routinely getting into MOPP gear due to Scud missile attacks. None of us felt safe in that place. Later in the war, a Scud missile would hit another barracks area with troops. Five years later, the apartment complex would be the site of a terrorist bomb.

The Desert and Preparing for the Ground War

Convoying to the desert was a whole new experience due to the massive number of vehicles headed north on Tapline Road and the time it took to travel approximately 300 miles. This experience would be repeated numerous times throughout the war and would be much slower moving across the desert. The tactical assembly area for the 201st FSB was far different than I imagined. The desert was completely barren, very rocky just below the surface and in the middle of January, very wet and cold. The terrain allowed for large distances between units so one felt very isolated. My first major surprise of the war was a significant change in the medical doctrine. The forward medical company was now to be reconfigured to be more mobile. All of our equipment had to be inventoried, sorted, and divided up into four armored command vehicles (M577) that would serve as treatment stations (Figure 1). As the medical platoon leader, the responsibility fell on my shoulders to ensure this was accomplished quickly. I soon discovered that there were many opinions among our five physicians and two physician assistants as well as a shortage of necessary equipment. Three major problems had to be corrected: a shortage of intravenous fluids, outdated and limited medications, and nothing with which to treat chemical casualties. In between this major endeavor were meetings, sick call, trips to the medical logistics areas, maintenance of vehicles, and taking care of the approximately 30 treatment platoon personnel. My typical day would begin at 0500 hours with an hour of "stand-to" in my fighting position and end at 2100 hours in complete exhaustion. There were hardly any days before or after the ground war when I was not busy throughout the entire day. Nothing in medical school or residency would have prepared me for the tremendous responsibility required with the job of platoon leader. Yet, as MC officers, the doctrine dictated that we assume command responsibility. I frequently relied on the three MSC officers within our company to keep me straight.



Fig 1. The armored tracked vehicle (M577) which was used as our treatment station.

The 1st Infantry Division eventually moved west in mid-February to set up a new forward assembly area in anticipation of the ground war (Figure 2). The 1st Infantry Division has a long history of being one of the first units involved in a conflict (for example, D-Day invasion during WWII) and were the natural choice to perform the breach operation through the Iraqi lines. This presented a number of challenges to the potential medical problems that we could encounter. We were told to expect casualties up to 60% of the engineering battalion during the breach operation if the Iraqis put up significant resistance. The next week was spent making final preparations such as practicing the breach operation through the Iraqi minefields and reviewing the medical annex to the operations order. Our brigade surgeon, MAJ Leroy Graham, did an



Fig 2. Camouflaged GP Medium tent which was home most of the time.

excellent job coordinating the interaction between all the medical units within the brigade along the different phase lines for the first days of the battle. I spent the last few days distributing botulinum toxin and ciprofloxacin tablets for the brigade. I had little idea what to expect when the ground war began.

The Ground War

In the waning minutes before 1,500, soldiers in the assault battalions of the "Big Red One" composed themselves for the attack, mindful of the projections that suggested 40% of them would be killed or wounded. Though many joked that an attack against trenches was more of the same for the "Big Red One" – like D-Day in Normandy – they still wondered who would be left. Those in the plow tanks did not wonder at all. Major General Thomas G. Rhame, 1st Infantry Division Commander, also considered casualties. As early as November, before he knew when, where, or against whom the 1st Division would attack, he focused his leaders on that very problem. Major General Rhame articulated his intent clearly: the 1st Division would mass fire and concentrate on a very narrow front. Tongue in cheek, he told commanders the idea was to win quickly with "enough of us left to have a reunion."¹

On the 24th of February, the ground war began in the VII Corps sector with the breach of the Iraqi lines by the "Big Red One" at 1500 hours. My medical armored command vehicle, along with two others, followed along behind the combat trains of the maneuver battalions and waited. My most vivid memories of the ground war were that I became very good at digging fighting positions and having little idea what was happening in front of me on the battlefield. Despite this, I was glad to be back into the exclusive role of physician. The first day was spent in anticipation of being very busy; fortunately, there were few casualties and, initially, none from the 2d Brigade. Our initial success was overwhelming. "Instead of needing 18 hours to break through Iraqi positions as originally calculated, the 1st Infantry Division successfully breached them in 2. During the breach operation, MG Rhame's division had destroyed the better part of two Iraqi divisions."²

The large numbers of enemy prisoners of war we

passed explained our lack of work. We moved through the breach the following day and it was less expansive than I had imagined. We spent a miserable night in inclement weather and trying to stay dry, warm, and awake for half the night proved to be very difficult. After that, the remainder of the ground war moved quickly as it seemed like constant movement for the remaining days. The weather improved dramatically and oddly enough, it felt rather peaceful driving through Iraq despite the amount of destroyed armament left in the wake of the Big Red One. We finally stopped, after 5 days, near the border of Iraq and Kuwait. The real medical work began that day when approximately 50 enemy prisoners of war were brought to our compound for treatment. Our tracks had linked up with the main body of the FSB and a supporting medical unit from the Iowa National Guard. Most of the injuries were shrapnel wounds and these patients were sent to the rear for definitive treatment. My internal medicine training came in very handy when an Iraqi soldier was found to be in a severe diabetic coma. Though the majority of injuries were not life threatening, we had completely outrun our medical support and had to rely on air evacuation to get these patients back to our supporting hospitals.

Safwan and the Peace Negotiations

Brigadier General RH Scales, Jr writes:

"Though I wanted to talk to Tom Rhame (CG, 1st Infantry Division) about Safwan, I first thanked him and his troops for their superb efforts during the war. I had given Tom the most varied combat missions and, in the night passage and attack, the toughest, and they had done what I'd asked with skill and courage. They felt good about it. I could see in the faces, hear it in the voice of the officers, noncommissioned officers, and soldiers I saw and with whom I talked. It was a different unit from the one I had visited on the eve of battle. They were now victorious veterans of mobile armored desert warfare. They would never be the same, and they knew it."²

The job of securing the Safwan airfield for the peace negotiations fell to 2d Brigade commanded by COL Anthony Moreno (Figure 3). The story of how he convinced the Iraqis to abandon the area without a fight is still recounted today. Since the honor of establishing much

of the security fell to 2d Brigade, some of our medical unit moved to the airfield to provide medical care if necessary. It was quite an idyllic time for our two medical treatment tracks and five ambulances stationed on the edge of the airfield for several days. The mail caught up with our unit, I was able to take a long overdue bath, and there was little to do except read and write letters, eat junk food from care packages, and look forward to the peace negotiations. The airfield was quite impressive with the number of Bradleys, Abrams, and captured Iraqi vehicles that lined its perimeter. There, in full view for everyone, was the sign which read "Welcome to Iraq – Courtesy of The Big Red One." The negotiations between General Scharwzkopf and the Iraqi commanders was brief and over within a matter of hours. We were left to take Blackhawk flights over the oil fires, enjoy a dinner of grilled steaks, and to call home courtesy of free satellite time from one of the networks (Figure 4).



Fig 3. A view of the Safwan airfield where the peace talks were held after the ground war.



Fig 4. A view of the oil fires from a Blackhawk helicopter.

The Long Months Afterward

Despite the quick victory over the Iraqis, the return of the Big Red One to Fort Riley would be a long process. As one of the last divisions to arrive in the Persian Gulf, we would also be one of the last to leave. The work didn't slow down either, as our mission changed several times. We stayed in the Safwan area for several weeks providing security for the demilitarized zone. It was a dangerous area due to unexploded ordnance that littered the countryside. Our only true mass casualty situation was a family of four children and their mother returning to Kuwait. They walked over an unexploded cluster bomb and it detonated killing two of the children instantly. We worked feverishly on the rest of the family, but lost one of the children due to massive bleeding from bilateral leg amputations. There were several other accidents, but none quite as dramatic. The area was filled with refugees who we were not allowed to treat except in emergency situations, packs of wild dogs, and the ever constant smoke belching from the oil fires not far away. There were many days when the smoke was thick enough that the midday sun was completely blocked out.

We eventually moved to an area to the west where the 1st Infantry Division covered positions for other withdrawing divisions. Back in the desert again, it was much more peaceful without the ordnance, refugees, and oil fires. There was little time to relax as there was quite a bit to accomplish before returning home. We continued to have daily sick call and a portable radiograph unit and primitive lab took care of most problems. I still called in the daily evacuation requests for soldiers who needed other types of care we could not provide. My primary responsibility now was to inventory all the equipment to prepare for redeployment. I also participated in cleaning the tracks and the other odd jobs that fell in my lap as the platoon leader. Our medical assets thinned out with the evacuation of our company commander, the retirement of a physician assistant, and the tasking for another physician to do sick call at a different site. My favorite job was serving as battalion volleyball coach, so I often made trips to other areas instead of being stuck in our compound in the intense desert heat all day long. My only encounter with refugee care occurred when they brought in an elderly Iraqi woman with complications initially reported as snakebite. I soon discovered the woman was completely hemiparetic on one

side from a stroke. Trying to explain it to this woman and her family without the aid of the translators from the battalion proved to be a formidable task.

We stayed in that area for a month until mid-April when we headed back to Saudi Arabia to an assembly area off Tapline Road. Here, I spent only a few days finalizing and packing the entire medical inventory, turning in all the narcotics to the medical logistics personnel and collecting all of the Mark I chemical kits. With that done, I abdicated my job as platoon leader back to the Medical Service Corps lieutenant and waited for the final word on my departure. All attached personnel from the division were sent back early through King Khalid Military City at the end of April, 2 weeks ahead of the entire division who returned to the port to load the vehicles.

Final Thoughts

My experience in the Persian Gulf War may have been vastly different from many of my physician colleagues. There are unique responsibilities and challenges to being assigned to a forward medical company for second echelon medical care. This was further dramatized by my role as medical platoon leader. It was a tremendous learning opportunity about the Army and, thankfully, not about our ability to take care of patients. Whether or not we can effectively save lives in the next conflict will depend upon the ability of the Army and AMEDD to learn from the Persian Gulf War. It is with great honor that I wear my 1st Infantry Division patch on my right shoulder. I always felt safe in the company of highly professional soldiers and never worried about their ability to get the job done. Given the opportunity, I would not want to be anywhere in the theater of operations except with the medical units in a division exemplified by the Big Red One. Danger Forward!

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Vision Readiness

LTC C. Donald McDuffie, MC, USA†

Optometry after-action reports from Operation Desert Storm (ODS) reveal that the vision readiness of the U.S. Army can be improved. The optimum state of vision readiness is achieved when the soldier is visually ready and optically ready. A soldier is vision ready when: (1) the soldier possesses the level of visual acuity required to perform his or her mission (visually ready) and (2) if medically required, the soldier possesses the correct number and type of prescription military eyewear (optically ready).

Preparation for Overseas Replacement/Preparation for Overseas Movement (POR/POM) data (see Table 1) collected from processing centers at 24 continental United States posts and six U.S. Army Europe posts reveal that 23% of the Army Active Component (AC) and 39% of the Reserve Component (RC) needed complete eye examinations prior to their deployment to the Persian Gulf.

	AC	RC	Total
Number of soldiers processed (screened)	157,570	98,171	255,741
Number of soldiers needing complete exams after screening	36,241	32,286	68,527
Percent needing complete exam	23%	39%	27%

Table 1. ODS Summary – Army Soldiers Not “Visually Ready” Prior to Deployment

This POR/POM data (see Table 2) also revealed that 44% of the deployed personnel (Army AC and RC) did not possess the appropriate number and type of military spectacles and/or prescription mask inserts prior to deployment.

As a result of the poor state of vision readiness prior to ODS, the Army, Navy, and Air Force optometry and ophthalmology service chiefs have taken action to alleviate this problem. The service chiefs formed the Defense Vision Information Services (DVIS) Fictional Process Improvement Work Group (FPIWG). The Assistant Secretary of Defense for Health Affairs first chartered the DVIS FPIWG in 1996 to plan, implement, and execute functional process improvements in the areas of vision readiness, vision conservation, clinical vision services, resource management, and on-line expert referencing. The U. S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Tri-Service Vision Conservation and Readiness Program (TVCRP) is the action office for the Defense Vision Information System FPIWG.

	Total (AC and RC)
Number of soldiers processed (screened)	255,741
Number of soldiers not “optically ready”	112,526
Percent not “optically ready”	44%

Table 2. ODS Summary – Army Soldiers Not “Optically Ready”

In 1997, the TVCRP conducted a Vision Health Readiness study at 13 Department of Defense (DOD) sites. The purpose of this study was to generate fact-based requirements for DVIS project development. This study found that 17.6% of active duty personnel (see Table 3) would require complete exams prior to their deployment and 45.8% of these active duty personnel (see Table 4) would require the fabrication of military spectacles and/or prescription mask inserts prior to their deployment.¹

Branch	Percent Not Vision Ready	Number Not Vision Ready
USA	21.3%	322
USAF	7.5%	41
USN	17.6%	121
USMC	17.7%	20
Total	17.6%	504

Table 3. Percent of Personnel by Branch of Service Not "Visually Ready"

Branch	Percent Not Optically Ready	Number Not Optically Ready
USA	52.6%	718
USAF	38.5%	264
USN	59.2%	186
USMC	33.1%	129
Total	45.8%	1297

Table 4. Percent of Personnel by Branch of Service Not "Optically Ready"

In 2000, the TVCRP conducted a vision readiness study at seven DOD sites. Unit vision screenings were conducted to measure service members' visual acuity and ensure that the service members possessed the appropriate number and type of prescription eyewear, if medically required. This study found that 45.6% of the active duty personnel at these sites did not possess their required military spectacles and/or protective mask inserts.²

The results of the 1997 Vision Health Readiness Study and the 2000 Vision Readiness Study led the DVIS

FPIWG to develop a proposed vision readiness standard that calls for annual vision readiness screenings. In addition, the DVIS FPIWG developed a vision readiness classification system to assist line commanders in determining their soldiers' ability to deploy based upon their current state of vision readiness.

To facilitate individual and unit level vision readiness tracking capabilities, the Composite Health Care System II (CHCS II) has under development a Medical Readiness screen. Currently, there are placeholders on the CHCS II Medical Readiness screen for tracking the following vision readiness information: correction required, last eye exam date, glasses received/date, contacts received/date, protective mask inserts required/date received and eye protection/received. When integrated with clinical eye care documentation and Spectacle Request Transmission System II functions, the Medical Readiness screen will provide enhanced tracking capabilities for vision readiness.

Even with a sophisticated vision readiness tracking capability in place, command emphasis will be critical to its success. Strong emphasis on vision readiness will need to reach the squad leader level. It all comes down to leaders taking care of soldiers.

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Goat Team One: Chemical Casualty Care Teams

COL Gary Ripple, MC, USA†

During Operation Desert Storm (ODS), the U.S. Army Medical Research Institute of Chemical Defense (ICD) deployed a forward team of eight chemical casualty care experts to Southwest Asia. The team, led by ICD's Commander, COL Mike Dunn, was attached to Army Forces Central Command (ARCENT), operated under the direction of the U.S. Central Command (CENTCOM) Surgeon, and supported U.S. and allied coalition forces in the theater. Its mission was threefold: (1) training medical officers on the recognition, decontamination, and treatment of chemical casualties; (2) providing on-site consultation in chemical casualty care processes; and (3) assessing the effectiveness of our medical countermeasures to what was anticipated to be the first exposure of U.S. forces to chemical attack since World War I.

The Goat Team name came in September 1990 when COL Dunn briefed the Commander in Chief (CINC), General H. Norman Schwarzkopf, on ICD's initiative to ultimately graduate 1,600 medical personnel from an in-theater 3-day adaptation of ICD's course, the Medical Management of Chemical Casualties. The course, when given at Aberdeen Proving Ground, used an animal laboratory exercise to train students in antidote treatment for nerve agent exposure. In peacetime, ICD's exportable course relied on either a hands-on laboratory exercise using goats, or videotaped instruction without animals. When he realized where the briefing was going, General Schwarzkopf called a halt and said, "Doc, let me get this straight, you're gonna take these goats and make them sick, then your students are gonna treat them and make them better, and then you're gonna have to kill them?" COL Dunn said, "You got it, Sir." The CINC responded, "Of all the decisions I was expecting to have to make today, I didn't expect this one. I'll get back to you." The decision days later was to use the videotape and no live goats, but the name stuck, both with the instructional team in the fall and the expanded team that participated in Desert Storm.

When it split into three cells, the CENTCOM Surgeon's staff naturally called them Goat Teams One, Two, and Three (Personal Recollection: COL Mike Dunn, MC, U.S. Army).

Goat Team One consisted of COL Mike Dunn, MC, and then-LTC Gary Ripple, MC; Goat Team Two was LTC Jill Keeler, AN, and COL Gary Hurst, MC; and Goat Team Three included MAJ Robert Gum, MC, CPT Michael Lewis, MS, and SGT Ronald Marek. Lieutenant Colonel John Wade, VC, remained in Riyadh to provide staff support to the CENTCOM Surgeon and a communication link. Goat Team One linked up with the VII Corps Surgeon, Goat Team Two worked with the XVIII Airborne Corps Surgeon, and Goat Team Three supported the Marine Expeditionary Force Surgeon. The mission and the mobility of these teams allowed them to observe the condition of medical units throughout the theater of operations. This article describes my travels and findings with Goat Team One. To assist the reader, I have placed brackets [] around personal comments to separate them from factual events.

We departed Maguire AFB, NJ, on 18 January 1991 on a C-141 that we shared with a company of critically needed fuel truck drivers. We arrived in Dhahran on 20 January, and the odyssey began. Military vehicles were unavailable, so we rented two 1980-vintage Chevrolet Suburbans. The teams stayed together for several days visiting hospitals, other medical units, and headquarters located around Dhahran.

Our first visit was to then-COL Harold Timboe, XVIII Corps Division Surgeon. While there, we experienced our first Scud attack and had to scramble for and quickly sort out our individual protective masks which we had nonchalantly left hanging on a coat tree as we entered the building. [That was the last time any of us were

more than an arm's reach from our protective masks.] On the drive back to our billets, another Scud attack occurred – this time thwarted by a Patriot missile. [In retrospect, we must have looked pretty silly to the unmasked pedestrians running for cover. Three near-sighted colonels wearing protective masks in a beat up Suburban – COL Hurst driving while COL Dunn and I tried to read an Arabic street-map through our dusty ocular inserts in black-out conditions as we groped our way along the streets of Dhahran.]

Teams One and Two traveled next to Riyadh and ARCENT headquarters, leaving Team Three with its Marine Corps hosts. Most nights, air raid sirens announced incoming Scud missiles that were often heralded by loud explosions as Patriot missiles were launched and found their targets. These circumstances often resulted in long periods wearing personal protective masks until an all clear sounded. [Sleeping in a protective mask results in uncomfortable dyspnea from diaphragmatic fatigue.] While in Riyadh, Teams One and Two completed attachment orders to ARCENT and prepared to move into the unknown in our ancient Suburbans. On our way out of Riyadh, both vehicles proved unworthy of any long-distance travel (one developed a brisk oil leak and the other “died” with a frozen water pump and required towing (Figure 1). Our always resourceful leader, COL Dunn, somehow arranged a trade of these vehicles for two new Nissan pick-up trucks supplied by Japan for the war effort.



Fig 1. Goat Team One and Two transferring supplies on the roadside after both ancient suburbans broke down.

Our first stop was King Khalid Military City. [Nicknamed “Harmless” because CNN reported that one Scud that hit there had landed in a “harmless spot in the

desert.”] At this point, Goat Teams One and Two parted company. Team Two headed west up the Tapline Road to the newly-repositioned 44th Medical Brigade, and they spent the rest of the war training XVIII Airborne Corps’ medical personnel and deploying forward with them when the ground war began. Team One moved in with the VII Corps Surgeon’s (COL Bob Griffin) staff at the 332d Medical Brigade headquarters located near Hafar Al Batin, the major road junction of the Tapline Road with the main route to Riyadh. From Team One’s base, COL Dunn and I visited almost all VII Corps hospitals (Table 1). The rest of this article presents findings and observations made during these visits. [COL Dunn planned all our excursions and during our travels throughout the war we continued to encounter more than our share of Patriot-Scud interactions. COL Dunn earned the nickname “SCUD-Magnet.”]

127th Med Group	
31st CSH	22 Feb 91
128th CSH	17 Feb 91
377th CSH	22 Feb 91
403d CSH	22 Feb 91
341st Med Group	
159th MASH	28 Feb 91
345th CSH (-)	13 Feb 91
475th MASH	17 Feb 91
807th MASH	11 Feb 91
912th MASH	11 Feb 91
VII Corps Assets	
12th Evac	3 Feb 91
13th Evac	17 Feb 91
312th Evac	14 Feb 91
148th Evac	21 Feb 91
410th Evac	20 Feb 91

Table 1. VII Corps Hospitals and Dates Visited

We spent most of our days before the ground war travelling and teaching. Most remarkably, we traversed miles of unmarked desert (in Saudi Arabia and in Iraq during the ground war) using only a compass and a large-scale map using coordinates we obtained from tactical maps. Not once did we miss our objective or get lost even when we had to detour around ravines and areas of

impassable vegetation [which was a good thing considering we had no radio or ground positioning system (GPS)]. [Glad I paid attention to map reading during common task training.] Because we were travelling almost every day, we ate meals-ready-to-eat for most meals. We'd pick out lunch as we started off in the morning, throw it on the dashboard, and by lunchtime it was warm and ready to eat.

While bunking with the 332d, we weathered rainstorms and sandstorms, enjoyed lukewarm showers at least once a week, and learned the art of washing battle dress uniforms (BDUs) and underwear using two plastic washbasins. Some of us had fewer clothes and had to wash more often while others with more sets of BDUs let their laundry ferment under their cot until they accumulated enough to wash. As we drew closer to the ground war, COL Dunn obtained the use of a VII Corps High Mobility Multipurpose Wheeled Vehicle (HMMWV) by trading the Nissan truck and our portable training VCR-TV for use during our absence.

On one occasion after a long day of training the medics at the 159th MASH, we spent a memorable evening at their staging point in Saudi Arabia. The 159th MASH was an Army National Guard unit from Louisiana, and they prided themselves on living well. They fed us a tasty meal of spiced chicken, zesty green beans, and fresh rolls before escorting us to our private guest tent. Although we heard some commotion late into the night, we were too exhausted to investigate. We were told the next morning that the entire camp had staged a Mardi Gras parade complete with floats (decorated $\frac{3}{4}$ ton trucks), marchers, and a few M-1 tanks from a nearby unit.

When the ground war began, Team One made its way into Iraq through the combat zone to catch up with the 159th MASH – the most forward, completely set-up hospital in the VII Corps area of operations. [We picked the 159th because they were to be the most forward deployed hospital – not because of Mardi Gras or their excellent meals.] Colonel Dunn and I crossed the berm between Saudi Arabia and Iraq 24 hours after the ground war began, and we followed the same route paved by the 3d Armored Division during their push into Iraq. Again, with only a map and compass and without the aid of a GPS or radio, we traversed the battlefield passing several

burning vehicles, with at least one without one of its tracks. [I drove the whole time, and always stayed in the biggest and deepest tank track prints I could see, figuring that any active mine would have been detonated by the heavier armored vehicle.]

By the Lord's grace, we passed safely through the southern-most region of Iraq and caught up with a rear detachment of the 3d Armored Division. We stayed with them and at dusk joined a Patriot Battery that was heading in the same direction (Figure 2). As night fell, our pace slowed to a crawl driving in blackout conditions through open desert with about 8 feet between vehicles. At approximately 2300 hours, the column came to an abrupt halt. The Battery Commander's HMMWV came screaming down one side of the column and returned leading all his Patriot missile carriers up the other side. They "circled the wagons," put up their radar and antennae and prepared for a fire mission. We spent the night sleeping fitfully in our HMMWV, waking occasionally to watch flashes from firefights that were in progress all around us just over the horizon.



Fig 2. Patriot Battery on station in Saudi Arabia.

The next day, we spent a very long day travelling slowly to the 3d Army Division support area set up in the middle of Iraq. Along the way, we saw shelled-out bunkers, observed Iraqi prisoners being loaded onto 5-ton trucks, viewed enemy tanks with their turrets popped, and vast expanses of nothingness in the Iraqi desert. We reached the rear of the 3d Armored Division support area late that afternoon, and it was dusk by the time we completed receiving the most recent war situation report and an intelligence report on Iraqi movements and

chemical/biological threats. I suggested that we spend the night on the spot, but COL Dunn insisted that we push on to the 159th – only a short drive away according to him! With only coordinates to guide us, we headed in the direction of the 159th, carefully plotting distances on our map. When we finally reached the destination we had plotted on our map – it was pitch black with an overcast sky, no tents were visible, the wind was howling, and we were in the middle of hostile territory with two 9 mm pistols between us. For what seemed like forever (probably 30 minutes) we considered our best options for the night – stay put or go searching – when we heard the sounds of a UH-1 starting its engine. We couldn't see it at first, but when it turned on its landing lights to take off, it illuminated the immediate area and we discovered that we had halted our progress within 50 yards of the 159th's position.

The 159th Commander, LTC Mike Jennings, had been expecting us, and he provided us an area just outside the casualty receiving area to stow our gear. That night was interrupted intermittently as they received casualties – mostly lower extremity mine injuries in our troops and exposure injuries in Iraqi prisoners. Sadly, the 159th received casualties from a medical clearing company. The unit was in convoy when the last HMMWV apparently rolled over a mine. One officer died instantly when an unknown munition blew up, but miraculously the other passengers escaped significant injury. On hearing the explosion, several soldiers in surrounding vehicles rolled out of their vehicles into a prone firing position. One young female soldier rolled onto another munition and suffered a deep pelvic injury. She died during air evacuation to the 159th. [The 159th MASH proved itself as an exceptionally well-trained and efficiently run hospital. Hats off to this superb Army National Guard unit.]

Fortunately, the cease-fire was announced the following morning, but the pace didn't slow. The 159th continued to receive casualties and COL Dunn and I continued to monitor and investigate possible chemical exposures (Figure 3). Colonel Dunn and I assisted with patient care at the 159th when we were not investigating. One young soldier had reported being splashed in the face with an unknown chemical, and he was under observation when he developed respiratory compromise and was intubated. Colonel Dunn and I were out of the area

investigating a possible mustard exposure and the physicians on duty concluded that the soldier had been exposed to some unknown toxin as the cause of his respiratory compromise. When I arrived back at the 159th, I was asked to evaluate the patient who was febrile, hypotensive, and tachypneic on the ventilator with loud inspiratory rhonchi throughout. A quick gram stain established the diagnosis of pneumococcal pneumonia with pending sepsis, and intravenous antibiotics were begun immediately. The 159th Commander figured, as a pulmonary doctor with no assigned duties at the 159th, that I should accompany the patient on a UH-60 Blackhawk to manage the ventilator during the air evacuation to the 12th Evacuation Hospital in Saudi Arabia. During the hour flight the patient's septic symptoms began to resolve, he aroused, became combative and extubated himself. Fortunately, the patient did not require reintubation, and the remainder of the trip was uneventful. [The best part of this trip was my helicopter ride back to the 159th where I could survey the battlefield and take pictures.]



Fig 3. Burned Kuwaiti soldier in triage area at 159th MASH.

Although the Goat Teams had nearly real-time communication with all medical assets of the three Corps-level headquarters that they supported, and all the medical personnel in these units had been trained to recognize and were expecting to see chemical warfare agent casualties, the only event that appeared to represent a chemical agent exposure was a likely mustard injury that did not result from intentional weapon use. Two days after the cease-fire, Goat Team One was called to investigate a soldier with typical blisters on an upper arm (Figure 4). The soldier's

blisters and erythema after a symptom-free latent period postexposure were classic, and best fit an accidental mustard exposure during his exploration of an underground bunker complex that may have been in use in the earlier Iran-Iraq war. In that conflict there was known use of large quantities of mustard. Since later testing of his clothing could not confirm that trace amounts of mustard had been present, the exposure was only considered possible but unproven. To my knowledge, this was the only clinically recognized potential exposure of a U.S. or allied soldier to a chemical warfare agent.

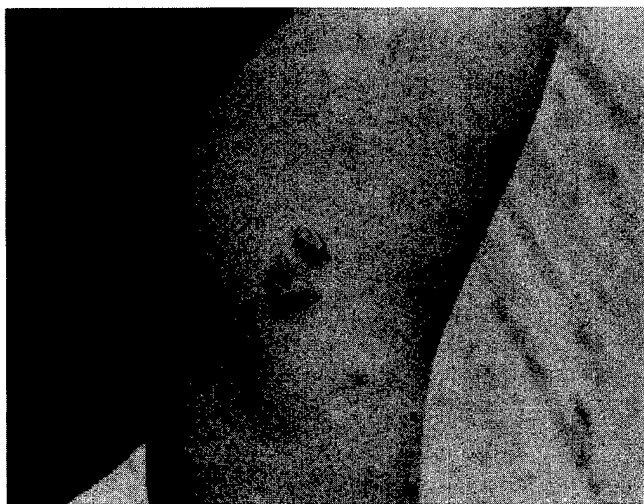


Fig 4. Presumed mustard exposure with typical blisters. Erythema was present but not visible in picture.

Several days after the cease-fire, all teams returned to Riyadh. The Goat Teams departed Saudi Arabia and returned home on 10 March 1991.

The remainder of this article presents my observations and findings from our visits to VII Corps hospitals. My observations are not an exhaustive treatise on the readiness of medical units in Desert Storm, and I present them to give the reader some understanding of the problems that medics faced during ODS. I will discuss seven topics that were a major concern to me during Desert Storm and that illustrate the difficulties encountered by the deployed medical units as they performed their clinical operations. Since Desert Storm, these problems and the lessons learned have led to correction of these issues and have significantly improved medical field operations.

Hospital Mobility

Forward deployed hospitals tasked to support combat elements moved slowly and lagged far behind the forward line of combat Forward Line of Own Troops (FLOT). In the case of the 159th MASH, the FLOT was more than 80 miles away which stretched UH-1 helicopter air evacuation capabilities. Most hospitals were never set up and none of the hospitals moving with VII Corps were fully functional during the first 72 hours of the ground war. Forward hospitals that were only partially set up or that were too far removed from the FLOT would have been incapable of treating large numbers of seriously injured casualties. The theater rear hospitals were too far away to allow swift evacuation by ground or air. Typical of the fast moving front described in the Army's Air Land Battle concept, the ODS front elements moved very rapidly. MASH and Combat Support Hospital (CSH) units, dependent on corps prioritized transportation assets, were slow moving and far from the action. Divisional and main support medical companies did keep pace with their divisions, but they did not have resuscitative surgical capabilities. Since ODS, forward surgical teams (FSTs) have entered the inventory. The FSTs can now keep pace with the forward elements of combat. They have capabilities to surgically stabilize and transport severely wounded combatants, and they are highly mobile when not set-up to receive patients.

Hospital Tentage, Set-Up, and Logistics/Resupply

Deployable Medical Systems (DEPMEDS) and Tent, Expendable Modular, Personnel (TEMPER) tents may be superior tents for fixed facilities, such as Evac hospitals, but they took extensive set-up time compared to conventional tents. In two separate instances, TEMPER tents at the 159th MASH and the 403d CSH were destroyed by high winds despite proper staking using conventional stakes into sandy soil. Also, the desert (sand) colored TEMPER tents shined with a bright orange hue at night if lights were turned on in their interior. This negated their camouflage at night and frustrated light discipline. A major concern found at many sites was that the DEPMEDS hospitals required a crane to load and unload equipment. In some cases, either the crane was never delivered or it became nonfunctional after delivery. The

best alternative was to locate a nearby unit's M88 tank recovery vehicle. Since ODS, the Army Medical Department (AMEDD) has re-engineered its concept of forward operation. Now, FSTs are light, relatively self-contained (3 days of supplies) and highly mobile. They can set-up, tear-down and move quickly in support of their responsible unit. They will require frequent resupply to insure uninterrupted operation. The CSHs are to be semi-fixed facilities using DEPMEDS equipment with its mission to receive wounded from the front. The AMEDD is continuing to test and improve tentage and equipment to maximize ground transport speed and maneuverability.

Patient Evacuation

Patient care doctrine for ODS relied heavily on swift patient evacuation, and much effort was expended to provide critical care facilities within and outside Saudi Arabia, especially in Europe. However, during ODS, limiting factors would have prevented transport of significant numbers of critically ill patients. Lack of adequate replacement personnel and equipment precluded transport of critically wounded patients requiring extensive life support. During ODS there was no established way of exchanging personnel and equipment to replace attendants and equipment required to transport critically ill patients. Due to the long distances between the FLOT and semi-permanent facilities, UH-1 Army air ambulances were constrained by limited areas of operation due to fuel restraints and mission requirements. Also during ODS, fixed wing transports contained too few assigned in-flight personnel to manage the expected numbers of critically injured patients. Since ODS, the Army and Air Force have improved coordination of air evacuation procedures.

Mechanical Ventilation

At the time of Desert Storm, the AMEDD did not have one standard ventilator for use in its DEPMED'S hospitals. In my travels around Saudi Arabia prior to the ground war, I surveyed each visited hospital and cataloged the ventilators they had for use (Table 2). At the time, the Bear® 33 and the Life Care® PLV-102 were the most versatile ventilators available because they were fully capable volume controlled ventilators powered by internal bellows. Also, they could provide high oxygen concentrations (with external oxygen supply), 20 cm of positive end expiratory pressure, and intermittent

mandatory ventilation. At the start of Desert Storm, the Impact® 700 ventilator was scheduled to become the ventilator for DEPMEDS hospitals. Interestingly, I found none of these ventilators at any hospital – probably because it requires an external pressure source from a medical quality air compressor. Less than 48 hours before the ground war began, then COL (now BG retired) Griffin asked me to report to the Corps Support Command (COSCOM) to help assemble a new shipment of pressure controlled transport ventilators. I arrived early the next morning and was informed that the COSCOM had received over 100 units, in pieces, ready for assembly; however, no instructions had been shipped with the units. By trial and error over the next 2 hours, we successfully assembled a working unit. A schematic of the assembly was drawn by hand, and a copy was placed in each unit. The units were then sent to their receiving units just hours before the ground war began. Since Desert Storm, ventilators have been improved and standardized; but at the time, considering the number of expected nerve agent casualties, ventilator type and numbers was a huge concern for medical commanders.

Durable Equipment

The DEPMEDS equipment supplied for ODS was not completely standardized and critical equipment was sometimes missing from the standard issued DEPMEDS. Basic monitoring instruments were often lacking in DEPMEDS hospitals (flow meters, in-line oxygen analyzers, electrocardiogram leads, etc). Although blood analyzers, electrocardiograph monitors, and ventilators were available, they were often a mixed variety and unfamiliar to personnel. Not uncommonly, hospitals were issued incomplete life support equipment. For example, a hospital might be issued a cell saver unit with no disposable liners available, blood warmers that were incompatible with available inserts, and MA-1 ventilator circuits with no MA-1 ventilator. Oxygen supplies were marginally sufficient in most hospitals, providing a 3-day supply of continuous use. During Desert Storm, some units were issued oxygen concentrators. Oxygen concentrators worked so well that they are now in common use and provide field units with a continuous oxygen supply. Since Desert Storm, all of these lessons learned have been corrected by standardizing and field-hardening DEPMEDS equipment.

Ventilator Type	Bennett® MA-1	Life Care® PLV 100 or 102	Bear® 33	Bennett® PR-2*	Anesthesia Ventilators
127th Med Group					
31st CSH	1	4	1		6
128th CSH	0	10	0	2	4
377th CSH	2	2	8	2	4
403d CSH	0	8	0		4
341st Med Group					
159th MASH	4	0	0	4	2
345th CSH (-)	0	0	0	4	4
475th MASH	4	5	0		
807th MASH	5	5	0	8	5
912th MASH	1	8	6	0	4
VII Corps Assets					
12th Evac	7	4	0	8	
13th Evac	0	0	9	0	6
312th Evac	2	4	0	0	0
148th Evac	2	8	0	2	
410th Evac	0	5	0	6	5

**“Monkey-faced” Intermittent Positive Pressure Nebulizer unit unfilled spaces indicate insufficient information

Table 2. Ventilator Support within VII Corps Hospitals

Hospital Security

Hospitals deployed into Iraq were set-up or positioned outside protected areas. When the VII Corps combat elements moved forward, hospitals were left without any external security and they had to rely on intrinsic security using light automatic weapons. Internal security consisted of soldiers with M-16 rifles that would have been ineffective against attack by terrorists or a by-passed Iraqi combat unit. The 159th MASH “captured” at least four Iraqi prisoners who walked up to a perimeter guard one evening [greatly surprising the small 19-year-old female medic at that guard post] and willingly surrendered. Had these Iraqis been motivated to cause harm, they would have severely disrupted or shut down operations at the 159th. Additionally, significant numbers of prisoners of war were treated and evacuated through the 159th MASH. If the Iraqi prisoners had been more aggressive, hospital security would have been significantly compromised.

Communication

Hospitals were dependent on communication provided by their medical group headquarters, which was not always co-located with the hospital. Not all ground ambulances contained radios, and they were often deployed into the war zone without land navigational devices or radios. This lack of communication was a major liability for forward deployed hospitals. Except for a radio to coordinate air evacuation, hospitals were dependent on their medical group. Since Desert Storm, the communication and land navigational problem have been solved.

Conclusion

The commentary contained in this article is one medic’s perspective of Desert Storm – gathered as I performed my assigned tasks as a pulmonary physician

and chemical/biologic expert. The events and observations discussed actually occurred and have been extracted from my personal diary. In this article, I attempted to capture a human side of Desert Storm without dwelling on the constant apprehension that we all felt regarding the chemical and biologic weapon effects we expected to encounter as a threat to our own lives and as medics responsible for the care of others. I also discussed some of the readiness issues that medics and hospitals faced while setting up and performing clinical operations. My discussions are not meant to be all-inclusive; they are to serve as examples to represent field medical conditions during ODS. Fortunately, in Desert Storm the AMEDD encountered few mass casualty situations, and most units received only minimal numbers of trauma patients and no chemical or biological casualties. Those of us in the AMEDD who served in Desert Storm returned home with a conviction to improve military medicine, especially field

medicine. Since Desert Storm, the AMEDD has spent countless man-hours and significant dollars studying the lessons learned and developing new equipment and doctrine to meet medical needs for future wars. To my knowledge, all of the issues discussed in this article have been corrected. The AMEDD, all of the medical units within the Active, Reserve, and Army National Guard inventory, and especially all of the individual soldiers who served, can be proud of their role in ODS. Because of Desert Storm, the AMEDD has greatly improved its readiness posture, and medics now are ready to provide the highest quality field medical support whenever and whenever needed.

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†Medical Corps, U.S. Army. At the time this article was written, COL Ripple was the Special Consultant to the Commander, Brooke Army Medical Center, Fort Sam Houston, TX. He has since retired from active duty.



Reflections on the Gulf War

MSG Paul V. Brown, USA†

As I reflect on my memories of the time I spent with the 15th Evacuation Hospital (now the 115th Field Hospital) preparing for and participating in the Gulf War over 10 years ago, most are now only fragments, lost by my lack of discipline in maintaining a personal journal. Still, there are memories worthy of sharing. Some are simply stories and others might be food for thought.

In the late 1980s, a typical duty day consisted of Red-Cycle nontraining taskings, details, and long hours in the motor pool. Training opportunities with the Vietnam-era Medical Unit, Self-Contained, Transportable (MUST) inflatable hospitals were limited and expensive. Broken zippers, buckles, leaking air bladders, and floors with holes were commonplace. Upon deployment notification, less than 50% of our authorized inflatable sections or "bubbles" were serviceable, despite our best efforts to maintain them.

The MUST hospitals deployed early in Operation Desert Shield were plagued by problems with sand in the turbine engines that powered the hospital. Projected casualty rates required the use of a majority of our table of organization and equipment hospitals, both Active and Reserve. We could not afford to have these hospitals literally deflating on our patients. The response was to expedite fielding of the now-familiar Deployable Medical System (DEPMEDS). After a "crash course" in DEPMEDS at the RTS-MED site at Camp Shelby, MS, we were ready to deploy. The equipment would be issued in theatre.

Constant changes to deployment timelines were a major source of frustration for both soldiers and their families. Housing arrangements for dependents and Family Care Plans were the greatest challenge throughout these delays. Approximately 2 months after the original deployment date, we finally were in the air.

The flight was long, but interesting. Everywhere you

looked, soldiers were actually studying their Common Task Training (CTT) manuals. It goes without saying that most pages were turned to the nuclear, biological, chemical (NBC) section; still others were quietly reading their Bibles. Others sat there in silence, a clear look of uncertainty on their faces. I distinctly recall this being the first time I fully realized these soldiers depended on the combined leadership of our officers and NCOs to bring them home safely. I picked up my CTT manual and began reading it myself.

Our pilot, a Vietnam veteran, offered words of encouragement as we landed in Saudi Arabia. He shared what he felt when he was a young man just landing in Vietnam, and wished us all the best. The flight attendants, all volunteers, waived little U.S. flags as we departed. Although it was a small gesture, it was a reminder that we were entering a conflict that had the support of our nation and others around the world.

The early days were certainly challenging. The myth that it doesn't rain in the desert was rapidly dispelled when several of our sleeping tents at the staging site went under 2 feet of water during the first heavy downpour. Soft sand was nowhere to be found. Wooden tent stakes were useless against the rock-hard ground. There must have been a "logistics bargain sale" at the unloading docks, since many units ended up short of equipment and portions of the DEPMEDS hospitals were missing or found in other organizations.

Field Hospitals have 500 beds, are doctrinally 20% mobile (actually less, in practice), and require a significant number of flatbeds to move. Given the limited number of military assets available, much of the transportation was contracted with the host nation. Among those transporting our equipment, oddly enough, were members of several Third World countries, but not one from Saudi Arabia. These drivers were very pleasant, polite, and extremely

observant. One cold night we had a series of NBC drills and several actual alerts (which would later turn out to be unwarranted). These same drivers, who were billeted at the edge of our base, were alarmed. Some of them wanted to leave, with our cargo still onboard. To assure them that nothing was wrong, a few of us removed our NBC gear and went to stay with them for a while. To our surprise, most of the drivers were perfectly content, smoking hashish and preparing for a feast of goat. We declined to partake in that part of the festivities, but gratefully accepted an offer of the best hot tea I have ever tasted.

A lot of hard work went into preparing the final site at Log Base Charlie and assembling the hospital (see figure). Under the leadership of COL (now MG) Kiley, the whole unit came together when it counted most. Senior officers were seen side by side with privates, filling sandbags, and preparing defensive positions. We knew that we were all working together toward a common goal.

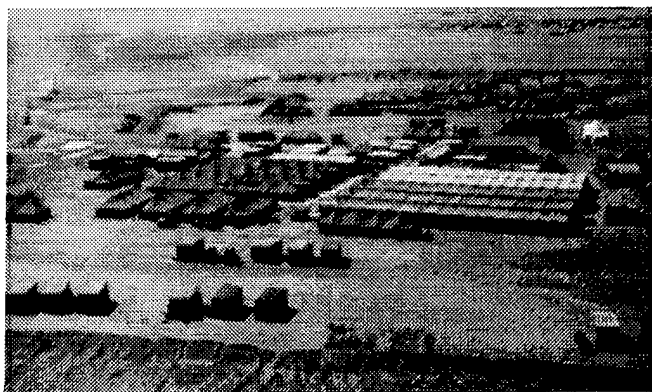


Fig. MUST hospital.

One of the proudest moments in my career was experienced when our first patients were flown in and admitted. Months of hard work and training were about to be put to the test. I stood on top of a military van vehicle, observing how well the litter teams, triage teams, and emergency room staff responded; all performed rapidly and appropriately; this enthusiasm never let up. Several medical evacuation pilots told us that they preferred landing at our hospital because we were fast and always ready; to me, this was the ultimate compliment.

The 15th Evacuation received dozens of Iraqi prisoner of war patients. Many were severely injured and required major surgery, from neurosurgery to amputations. With the exception of one Republican Guard patient (who had to be separated from the rest), all were very polite. A

few spoke English and shared horror stories of what they had been subjected to...the lack of food, water, clothing, and equipment. Some said their families would be harmed if they did not fight. Some acknowledged that we did not appear to be the "Great Satan" they were led to believe. Others shared pictures of their children with us.

Even sadder cases were the Iraqi civilians who came through our doors. Many children were covered with shrapnel wounds. One infant had so many holes in her head that every time she cried, cerebral spinal fluid leaked out. None of us were really prepared for this. We had planned to take care of soldiers. There were no diapers, infant or children sized tubes, etc. We were fortunate to have some very creative intensive care unit nurses and even a couple of Pediatric Nurses assigned with us. It is not exaggerating to say that without them, many of these children may not have survived.

Experiencing death is an inevitable part of hospital life; however, most of our young soldiers had never witnessed anyone dying, let alone been around a deceased body. Our first casualty turned out to be one of our own from the AMEDD family – a Medical Service Corps evacuation pilot who went down in Iraq. I'll never forget the looks on the faces of the small group of 91Bs I took in to assist with preparing his body. One soldier later wrote a very moving poem about the experience.

Of course, there is a wide range of memories; names like Danberg, Devin, Horton, and Fratina are representative of the fine NCOs who deployed and helped to make the mission a success. Burning excrement in barrels, living in former chicken farms, flies infesting the food, time waiting at Cement City (a temporary departure staging area) for our turn to leave, the reception from the community at the airport in Bangor, Maine, and all the families waiting for us very late at night upon our return.

The overall experience was great. The lessons learned have undoubtedly been used many times since. I believe we all learned to be flexible and "think outside the box." Even more significantly, we learned that we could trust one another to accomplish the mission; every one of our soldiers returned home safely.

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AMEDD Dateline(Desert Shield/Storm)

Wayne R. Austman PhD†

- 17 Jul Saddam Hussein publicly warned that he was willing to use force against Kuwait and the United Arab Emirates to stop them from "overproducing and driving down oil prices." (1990)
- 25 Jul Saddam Hussein summoned U.S. Ambassador April Glaspie to his palace and accuses the U.S. of conspiring with Kuwait to keep world oil prices low. He threatens acts of terrorism in reprisal and boasts that he will kill 10,000 Americans in one battle. (1990)
- 2 Aug Spearheaded by the Republican Guard armored corps, Iraqi forces invaded Kuwait. (1990)
- 7 Aug AMEDD joined in initiation of Operation Desert Shield. (1990)
- 12 Aug The commander of the 45th Medical Company of the 421st Medical Battalion received orders to commence unit self-deployment from The Federal Republic of Germany to Saudi Arabia. Thus commenced an operation which constituted "the longest helicopter unit self-deployment in the history of the U.S. Army." Between the morning of 21 August and the afternoon of 28 August 12, aircraft flew from Darmstadt to Dhahran and commenced operations immediately upon arrival. (1990)
- 15 Aug AMEDD bed capacity in theater stood at zero. (1990)
- 16 Aug Womack Army Medical Center at Fort Bragg, NC, lost most of its staff to fill out units assigned to Operation Desert Shield. Backfill for the center came from the Fayetteville, VA, Medical Center's 3274th Capstone unit. (1990)
- 4 Sep United States Army Institute of Surgical Research at Fort Sam Houston, TX, submitted a plan defining the burn care teams necessary for the theater of operations and described a system of burn patient management that would provide timely resuscitation, effective triage, safe aeromedical transfer, and expansion of tertiary burn care facilities to ensure optimum definitive care to minimize mortality and maximize functional recovery. A total of 64 burn casualties received treatment during the course of the Gulf War. (1990)
- 15 Sep AMEDD bed capacity in theater stood at 90. (1990)
- 15 Oct AMEDD bed capacity in theater stood at 292. (1990)
- 27 Oct Decision was made to activate the U.S. Air Force contingency hospitals in Europe. (1990)
- 1 Nov Stockage of Ringer's lactate at the USAMMCE depot in Kaiserslautern, West Germany, stood at 80,000 cases, compared to a normal peacetime stockage of 8,000 cases. (1990)

- 3 Nov 7th Medical Command operations contacted the Deputy Corps Surgeon, VII Corps, and requested the requirements to support a corps deployment. (1990)
- 8 Nov VII Corps officially received mission orders for deployment to Southwest Asia. (1990)
- 15 Nov AMEDD bed capacity in theater stood at 2,060. (1990)
- 6 Dec Five U.S. Army Reserve and Army National Guard medical units received mobilization orders for Operation Desert Shield/Storm. All five had deployed to Southwest Asia by 24 December. (1990)
- 15 Dec AMEDD bed capacity in theater stood at 2,060. (1990)
- 17 Dec 332d Medical Brigade deployed to Southwest Asia with the mission of managing all corps-level medical support assets. (1990)
- 1 Jan AMEDD deployed 13,580 beds in 44 hospitals (17 Army Reserve, 11 Army National Guard, 16 Active Component) in theater. These were supplemented by nine host-nation fixed facilities and 1,800 beds in Europe as well as another 1,700 beds in CONUS. The National Disaster Medicine System readied a plan to provide an additional 25,000 beds if necessary. (1991)
- 15 Jan AMEDD bed capacity in theater stood at 4,080.
- 19 Jan AMEDD suffered its first casualty of the conflict when SSG Garland V. Hailey died of a nonbattle injury (NBI). Twelve more AMEDD soldiers' lives would be claimed by NBIs by 12 March. (1991)
- 29 Jan Iraqi field medical support system was called on to perform in earnest when elements of 3d Marine Regiment/1st Marine Division strike an Iraqi armored column with artillery fire in the predawn darkness as it launches an attack on the Saudi town of Khafji on the Red Sea coast. The ground war had begun. Allied medical support facilities had 30,000 units of blood on hand. Central Command planned on needing 6,000 pints of blood per day once combat began. Projected probable allied casualties at this point were estimated at 15,000 dead and 30-40,000 injured/wounded. (1991)
- 30 Jan As the fighting built around Khafji, 12 marines were killed by a misdirected airstrike in the first "friendly fire" incident of the war. (1991)
- 1 Feb AMEDD strength on active duty reaches 87,487, the largest since World War II. More than 23,000 AMEDD personnel (55% Reserve Component) were deployed to Southwest Asia. (1991)
- 2 Feb French physicians were deployed to their prepositioned units in-theater after a 30-hour movement from France. (1991)
- 15 Feb AMEDD bed capacity in theater stood at 13,580. (1991)
- 17 Feb 251st Evacuation Hospital (SC ARNG) began patient care operations in Southwest Asia. By the time it suspended operations on 26 April, it had admitted 2,250 patients, and performed 428 major operative procedures. Outpatient services recorded 36,374 visits at what was described as "the busiest hospital in theater." (1991)

- 23 Feb At 1502 hours, Physician's Assistant CW2 Thomas F. Haigler crossed into Iraq with the 3d Squadron, 2d Armored Cavalry Regiment, as it spearheaded the VII Corps drive to fix and destroy the Iraqi Republican Guard. (1991)
- 27 Feb 1LT Daniel E. Graybeal, MS, and SSG Michael R. Robson were the first AMEDD soldiers killed in action in the Gulf War. (1991)
- 28 Feb SPC Cindy M. Beaudoin and MAJ Mark A. Connelley, MC, were killed in action. A temporary cease-fire instituted on this date ended the so-called "100 Hour War." (1991)
- 1 Mar Third anniversary of Saddam Hussein's use of mustard gas to kill 5,000 rebellious Iraqi Kurdish tribesmen. (1991)
- 10 Apr Operation Desert Shield/Storm concluded with signing of official cease-fire by Allied and Iraqi forces. By this time, AMEDD units had treated 22,000 inpatients and 140,000 outpatients in the war zone. One hundred forty-eight American service members had been killed in action and 467 were wounded. Of these, 35 were killed and 72 were wounded by friendly fire. (1991)

†Dr. Austerman is the Historian, U.S. Army Medical Department Center and School, Fort Sam Houston, TX.





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WRITING AND SUBMITTING ARTICLES FOR THE AMEDD JOURNAL

The AMEDD Journal is published quarterly to expand knowledge of domestic and international military medical issues and technological advances; promote collaborative partnerships among Services, components, Corps, and specialties; convey clinical and health service support information; and provide a peer-reviewed high quality print medium to encourage dialogues concerning health care initiatives.

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